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FLIGHT PLAN FILING BY SPEECH RECOGNITION.(U)  
JUL 82 E SMOCHET, L DELEMARRE, P QUICK

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## Flight Plan Filing by Speech Recognition

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July 1982

Final Report

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16. Abstract <p>The purpose of this effort was to develop and demonstrate the capability of automatic flight plan filing by machine recognition. In 1979, the Technical Center undertook an extensive effort to upgrade the Utterance Recognition Device (URD) in preparation for testing the capabilities of voice input for automatic flight plan filing. The URD was modified to include more reliable components, where advisable, and a larger memory to handle the expanded vocabulary. In addition, a dialect study was conducted to determine the locations for collecting a nationally representative voice sample in order to create reference patterns capable of performing well on all American dialects. Subsequently, over 5,000 voices from 24 cities throughout the United States were collected and processed.</p> <p>In January 1981, initial tests were conducted in which subjects filed simulated flight plans directly into the URD over the telephone. The results indicated that the prototype system, as demonstrated using the adaptation strategy for flight plan filing, has definite potential for application in Model 2 of the Flight Service Automation Program. Moreover, a comparison between the old and new recognition algorithms indicates that the improvement in accuracy with the new data base would raise the performance of the Mass Weather Dissemination Program to a level quite satisfactory for the general pilot population.</p>			
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# PREFACE

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## EXECUTIVE SUMMARY

One of the products of the Flight Service Station Engineering Laboratory located at the Federal Aviation Administration (FAA) Technical Center is an engineering model designed to explore, through development, test, and evaluation, the application of digital technology to the mass dissemination of meteorological and aeronautical information. A major component of this system is an Utterance Recognition Device (URD) used for recognition of human speech over telephone lines. In the latter part of 1979, the Technical Center undertook an extensive effort to upgrade the URD in preparation for testing the capabilities of voice input for flight plan filing.

The URD was modified to include more reliable components, where advisable, and a larger memory to handle an expanded vocabulary. To improve recognition accuracy and provide greater convenience (i.e., error-free recognition without cumbersome repetition and annoying question and answer dialogue), it was essential to develop sufficient capability to handle differences in pronunciation due to the regional variation in speech between individuals. With the assistance of outstanding linguists in American dialects, a dialect study was conducted to determine the locations for collecting a nationally representative voice sample for use in creating reference patterns capable of performing well on all American dialects.

The consensus of the experts suggested a speech sample from the locations and dialect areas shown in figure E-1. The target sample was (100 male and 100 female) from each location indicated in figure E-1. Each subject read the words in the special purpose vocabulary over the telephone into a recording device. The voices of the individuals reading the list of words were later processed into a vocabulary data base.

The voice collection effort began in February 1980 and ended in January 1981. During this period, 5,617 voices were collected and processed into a vocabulary data base; 2,251 voices were recorded from FAA personnel. It was extremely difficult for the Technical Center to unilaterally find diversity and number of speakers required within the staff of FAA alone. For this reason, two other government agencies were asked to assist the Technical Center in the collection of data. Subsequently, an additional 3,366 voices were recorded from employees of the Internal Revenue Service and Social Security Administration.

The hardware modifications were made in April of 1980. The new vocabulary data base and recognition software were installed in November 1980. In January of 1981, initial tests were conducted in which subjects filed simulated flight plans directly into the URD over the telephone. Fifteen subjects (12 male and 3 female) from the Technical Center participated in the initial test. Fourteen subjects tested were inexperienced users. That is to say, they were untrained and inexperienced in talking to an utterance recognition device. One subject, experienced in talking to word recognition machines, was used in the test for the purpose of comparison. Three of the subjects were general aviation pilots. The subjects differed in cultural and geographic origin.

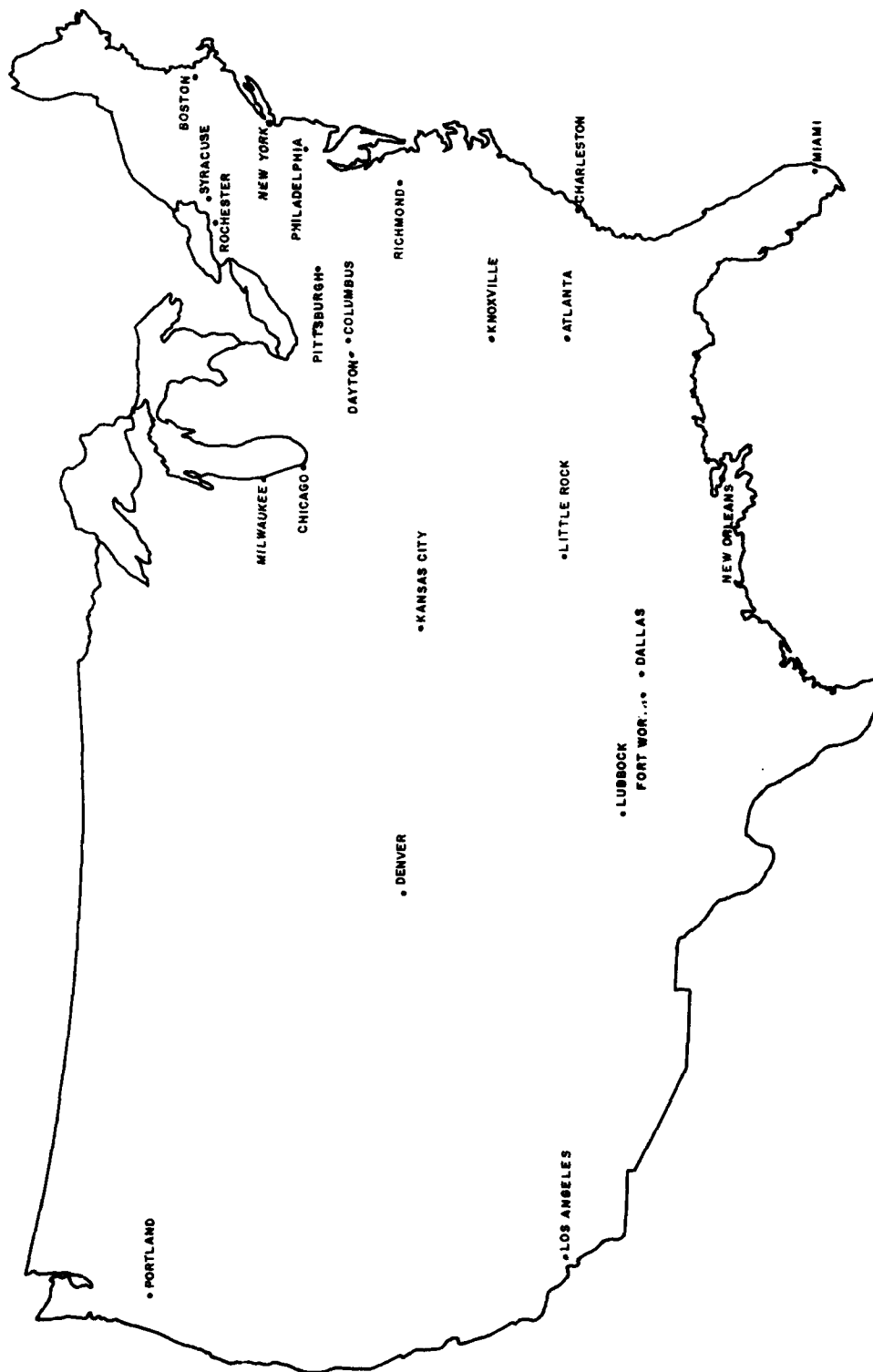


FIGURE E-1. LOCATIONS FOR VOICE COLLECTION

Using the phonetic alphabet, a set of numbers, and several control words, each subject entered four simulated flight plans — two with visual flight rules (VFR) and two with instrument flight rules (IFR). However, not all of the flight plan data were entered by voice recognition. As would reasonably be expected, the requirement to spell out every flight plan entry phonetically reduces the attractiveness of computerized word recognition or any other direct character-by-character entry system (i.e., Touch Tone™ or pilot self-briefing terminal (PSBT)) for flight plan filing. The fact is that, even at 100 percent accuracy, the protracted length of the transaction seriously diminishes the attractiveness of filing in this manner.

As a rule, the speech channel loses its appeal as the language departs more and more from natural speech. On the other hand, by handling only those entries that are sent to the National Airspace System (NAS) or destination Flight Service Station by utterance recognition and the remaining entries by prompted recording, the protocol is more natural and compatible with the task situation. This approach is based on our assumption that the requirement to spell out every flight plan entry character by character would try the patience of the users.

The results of the initial test are summarized in table 2, in the Results section of this report. The numbers in column 2, "Total Words Spoken," are the total number of words spoken by the subject in entering all four flight plans. Column 3, "Please Repeat," shows the number and percentage of utterances that were unrecognized by the computer. This occurred when the computer could not make an identification and, therefore, asked for a repeat speech sample. Column 4 reflects the number and percentage of misrecognized words. Not all unrecognized and misrecognized words were due to system error. A significant amount were a result of user errors, such as speaking words that were not in the vocabulary data base, speaking two or more words at a time, not confirming an entry with a "yes" or a "no," speaking before the cue-tone, etc. Nevertheless, the majority of misrecognitions were the result of system error. Column 5 shows the accuracy of the flight plans as finally completed after corrections. The percent of accuracy was determined by dividing the number of words recognized correctly by the number of words in the flight plans. As reflected in column 5, 10 out of the 15 subjects were able to file flight plans (two VFR and two IFR) that were 100 percent accurate. The flight plan accuracy attained by the other five subjects ranged from 93.2 to 99.4 percent. The total number of words spoken by the subjects shown in column 2 exceeds the number of words in the flight plans as shown in column 5. The reason for this is that each entry must be confirmed with a "yes" or a "no" (affirmative or negative). It is important to note that the overall accuracy after corrections for all of the flight plans combined was 99 percent. In short, the results of the initial test are exceptionally encouraging. It appears that the dialect study and the voice collection effort led to an outstanding improvement in recognition accuracy.

In March 1981, a comparison was made between the old and new recognition algorithms. A test set of 200 voices was entered against the old and new reference patterns in order to gauge the improvement in recognition accuracy. The test set was not used in the construction of the reference patterns and was selected across recorded dialects. Judging from the results, as shown below, it would be reasonable to assume that the improvement in accuracy with the new data base would raise the performance of the Mass Weather Dissemination Engineering Model to a level quite satisfactory for the general pilot population. The model only uses the following three vocabularies:

<u>Improved Reference Patterns</u>	<u>Accuracy With New Data Base</u>
1. "North, South, East, West, and Local"	97.2 percent
2. "Yes, No, Affirmative, and Negative"	97.9 percent
3. "File, Briefing, Specialist, Close, Amend"	96.5 percent

Since the test set included a broad range of American dialectal variation, it was considered to be a reliable gauge for estimating how well the system might perform on a nationwide basis.

After studying the test results, it was concluded that:

1. The prototype system, as demonstrated using the adaptation strategy for flight plan filing, has definite potential for application to an enhanced Model of the Flight Service Automation Program.
2. The requirement to spell out every flight plan entry character by character would try the patience of the users. Even at 100 percent accuracy, the increased length of the transaction diminishes the attractiveness of filing in this manner.
3. The improvement in recognition accuracy with the new data base would raise the performance of the Mass Weather Dissemination Program to a level quite satisfactory for the general pilot population.
4. The dialect study and voice collection effort led to an outstanding improvement in recognition accuracy.

The following recommendations are made:

1. Simplify the procedure for filing a flight plan by voice recognition. Obviate the necessity for the pilot to spell out every flight plan entry character by character.
2. Develop additional software to allow for further correction and edit capability.
3. Develop written instructions for training general aviation pilots on how to use the system effectively.
4. Install a telephone line in the Millville, New Jersey, Flight Service Station to allow volunteer general aviation pilots to access the system at the Technical Center and file simulated flight plans by machine recognition. Project personnel should collect objective and questionnaire data on system performance. (Note: Approval from OMB must be obtained prior to testing.)
5. Encourage user growth by permitting the system to become progressively more flexible with greater efficiency of input as the user's skill and confidence increase.

## INTRODUCTION

### PURPOSE.

The purpose of this effort was to develop and demonstrate the capability of automatic filing of pilots' flight plans by computerized word recognition. This report presents the results of that effort.

### BACKGROUND.

A major component of the Mass Weather Dissemination Exploratory Engineering Model located at the Federal Aviation Administration (FAA) Technical Center is an utterance Recognition Device (URD) used for recognition of human speech over telephone lines. It is the only known commercially available recognition machine in the United States designed for use on a switched telecommunications system. In 1979, the Technical Center was given the task by the Systems Research and Development Service (SRDS) to develop and demonstrate the capability of automatic flight plan filing by machine recognition. In response to the request from SRDS, the Technical Center undertook an extensive effort to upgrade the URD in preparation for testing the capabilities of voice input for automatic flight plan filing. The URD was modified to include more reliable components, where advisable, and a larger memory to handle the expanded vocabulary. Moreover, a dialect study was conducted to determine the locations for collecting a nationally representative voice sample in order to create reference patterns capable of performing well on all American dialects. Subsequently, over 5,000 voices from 24 cities throughout the United States were collected and processed.

## SYSTEM MODIFICATIONS

### HARDWARE.

The URD improvement program included the purchase of four new components to the URD system. These components were (1) a new floppy disk subsystem; (2) an extension of the internal D memory from 250 to 500 kilobytes; (3) a solid-state voice response unit with a capability of 96 words; and (4) a new analog bay incorporating a number of improvements.

FLOPPY DISK SUBSYSTEM. The old floppy disk was a Dynastor model which operated at a very high speed and utilized a floating head which did not physically contact the storage medium. The disk was excellent for systems which remained operating constantly over long periods of time, since the medium did not wear out. Standard floppy disks had a wear problem in the days when the URD was first designed. The URD had many interruptions and changes in media due to the nature of development work. The starting and stopping of this high speed system caused a large percentage of system failures. In addition, the single Dynastor did not have the storage capacity required for the expected new programs and the large data base necessary to change the flight plan filing program. Consequently, the Dynastor was removed, and a dual DSD 440 floppy disk was installed in its place. The new disk has twice the capacity, is not subject to difficulties from repeated loadings and unloadings, and exhibits only little more wear than the Dynastor.

FIVE HUNDRED KILOBYTE D MEMORY. The D memory is the main fast and volatile storage of programs and data base for the URD. The increase in data base size from 25 to 75 words in the data base (vocabulary memory) required this extension to the systems capabilities.

SOLID-STATE VOICE RESPONSE UNIT. The URD depends on its own voice response to verify the word or string of words spoken before they are passed to the Interdata 7/32 computer. It has special routines to accomplish this and requires that each word in the vocabulary, as well as prompting or questioning phrases, be included in the Voice Response Unit (VRU). The previous system, a Cognitronics "speechmaker," was based on a revolving optical drum and was limited to 31 words. Verbex, the manufacturer of the URD, had a new solid-state system based on the storage of compressed digitized speech on 16 kilobyte E proms, one for each word of about one-half second. The new system had a capacity of 96 words and was considerably more reliable than the revolving drum.

NEW ANALOG BAY. The analog bay is that part of the URD that handles the eight channels of telephone signals. It contains the amplifiers, channel switches, analog to digital converters and a number of diagnostic subsystems. The new analog bay was selected to replace the old one because it possessed the following features: (1) better grounding reducing occasional cross talk on the telephone channels; (2) automatic gain setting amplifiers which compensated for weak or strong telephone lines; and (3) system diagnostic provisions which were developed after the previous URD was built.

#### SOFTWARE.

The major reason for the new software was to change the capability from the weather dissemination routine to the flight plan filing routine. Since the latter is a more extensive program with regard to word recognition, two major changes were made with respect to the previous program. The first of these was the ability to enter words in strings of from two to five words separated by prompting "beeps." The string was then verified by being repeated with the voice response unit. The second major change was that, once the user verified a string, each of the words spoken were adapted to the stored patterns and became a new data base word during the current telephone call and only on that caller's channel. This transparent training of the system to the user's voice considerably improves the accuracy of recognition upon subsequent use of those words.

In addition to these capabilities, the new software program controlled the automatic gain setting of the channel amplifiers, controlled the verification and voice response routines, and provided for more extensive diagnostics. The system was also designed so that the 7/32 computer could command any of 15 subvocabulary groups as appropriate to the current flight plan entry. Since these groups were considerably smaller in number of words than the whole vocabulary, this resulted in a significant increase in the probability of correct recognition.

#### DIALECT STUDY.

To help assure accuracy and convenience (i.e., error-free recognition without cumbersome repetition and annoying question and answer dialogue), it was essential to develop the capability to handle different pronunciations of a given word due to the variation in speaker dialects. Thus, a dialect study was conducted with the assistance of outstanding linguists in American dialects. The purpose of this study was to determine the locations for collecting a nationally representative voice sample for use in creating reference patterns capable of performing well on all American dialects. One of the major difficulties in speech recognition is the variation in speech between individuals. It is important to note that the problems of dialect differences, in relation to speech recognition, are a relatively new area of investigation.

The design and results of the dialect study can be found in report number FAA-RD-80-115 entitled "An Investigation into the Effects of Dialectal Variation on Flight Plan Filing by Machine Recognition" dated January 1981.

The dialectal variations in pronunciation are generally written in International Phonetic Association (IPA) symbolism. However, this notational system is so highly specialized that readers outside this area of specialization could not be expected to understand it. Therefore, to give the reader some idea of the actual distinctions in dialect differences, a recording is contained in the above mentioned report (FAA-RD-80-115) which includes selected regional pronunciations of the words in the expanded vocabulary.

#### VOICE COLLECTION.

The dialect study identified 24 cities for voice collection. The voice collection effort began in February 1980 and ended in January 1981. During this period, 5,617 voices were collected and processed. The Technical Center arranged for personnel in those cities to call a recording station located at Verbex, Incorporated, of Bedford, Massachusetts. The voices of the individuals reading the list of words were recorded for later processing into a vocabulary data base. Originally, 2,251 voices were recorded from FAA personnel. It was extremely difficult for the Technical Center to unilaterally find the number and diversity of speakers required within the FAA alone. Subsequently, an additional 3,366 voices were recorded from employees of the Internal Revenue Service and Social Security Administration who participated in the data collection. Table 1 shows the number of recorded calls by location.

TABLE 1. RECORDED CALLS FROM PREDETERMINED DIALECT AREAS  
THROUGH MARCH 7, 1981 (END OF PROGRAM)

	<u>FAA</u>	<u>IRS/Social Security</u>	<u>Total</u>
Chicago, Ill.	68	235	303
Atlanta, Ga.	181	239	420
Boston, Mass.	158	77	235
Los Angeles, Calif.	77	278	355
Rochester/Syracuse, N.Y.	22	74	96
Dayton/Columbus, Ohio	54	97	151
Philadelphia, Pa.	101	296	397
Labbock, Tex.	53	26	79
Knoxville, Tenn.	38	47	85
Metropolitan N.Y.C.	220	256	476
Pittsburg, Pa.	95	207	302
Charleston, S.C.	34	38	72
Denver, Colo.	121	75	196
Portland, Oreg.	141	109	250
Kansas City Mo./Kans.	174	167	341
Little Rock, Ark.	109	104	213
Milwaukee, Wis.	91	136	227
Richmond, Va.	50	192	242
New Orleans, La.	88	88	176
Fort Worth/Dallas, Tex.	155	78	233
Miami, Fla.	57	49	106
North Carolina*	--	116	116
City not available**	<u>164</u>	<u>382</u>	<u>546</u>
TOTAL CALLS	2,251	3,366	5,617

\*A special effort was made to record voices from the coastal areas of North Carolina in addition to those locations identified in the dialect study.

\*\*Callers did not indicate the city they were calling from.



## PROCEDURE

The hardware modifications were made in April of 1980. The new vocabulary data base and recognition software were installed in November 1980. In January of 1981, initial tests were conducted in which subjects filed simulated flight plans directly into the URD over the telephone. Fifteen subjects — twelve male and three female — from the Technical Center participated in the initial test. Fourteen subjects tested were inexperienced users. That is to say, they were untrained and inexperienced in talking to an Utterance Recognition Device. One subject, experienced in talking to word recognition machines, was used in the test for the purpose of comparison. Three of the subjects were general aviation pilots. The subjects differed in cultural and geographic origin. They indicated the following geographic areas as best representing their accent: West Virginia, New York City, Northern Pennsylvania, Virginia, Southern New England, South Jersey, Central New York State, Philadelphia, Upper Ohio Valley, Central Pennsylvania, Southeastern Pennsylvania. In addition to the above, one subject identified his accent as "General American."

Each subject entered four simulated flight plans: two VFR and two IFR. However, not all of the flight plan data were entered by voice recognition. As would reasonably be expected, the requirement to spell out every flight plan entry phonetically reduces the attractiveness of computerized word recognition or any other direct character-by-character entry system (i.e., Touch-Tone™ or pilot self-briefing terminal) for flight plan filing. The fact is that even at 100 percent accuracy, the protracted length of the transaction seriously diminishes the attractiveness of filing in this manner. As a rule, the speech channel loses its appeal as the language departs more and more from natural speech. On the other hand, by handling only those entries that are sent to the National Airspace System or destination Flight Service Station by machine recognition and the remaining entries by prompted recording, the protocol is more natural and compatible with the task situation. Using the standard flight plan (FAA Form 7233-1), figures 1 through 4 show the entries in the test made by machine recognition and those made by prompted recording. The shaded portion of each flight plan indicates the entries made by voice recognition. The unshaded portion indicates the entries that were recorded. The phonetic alphabet, the digits zero through nine, plus the numbers "hundred" and "thousand" and a set of control words were used for making entries by voice recognition. The recorded entries were made in natural language.

To illustrate the order in which the information was entered and the structure of the dialogue, a verbatim transcript of one test subject's actual transaction is shown in figures 5 and 6. Figure 5 is the protocol used for a VFR flight plan. Figure 6 shows the IFR protocol. The user-computer dialogue has a resemblance to normal human conversation. This enables the system to be compatible with human cognitive style.

There are two automatic error correction routines which occur when "no" is received instead of "yes" after verification. When "no" is received after a string is entered, the URD says "Sorry, try again." After the string is reentered and a "no" received again, the URD says "Sorry, was the first word \_\_\_\_?" If "yes," it says "Was the next \_\_\_\_?" If "no," it says "What was it?" If the answer to that was, for example, "5," the URD will say "Did you say 5?" If the response by the caller is "yes," it will store the word and move on to the next, etc. If the response is "no," it will eliminate "5" from the vocabulary and say "What did you say?" In this fashion, it will soon find the correct word as long as "yes" and "no" are properly recognized.

Form Approved: OMB No. 04-R0072

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION <b>FLIGHT PLAN</b>		<b>CIVIL AIRCRAFT PILOTS.</b> FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed \$1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.			
YES NOVEMBER SEVEN THREE SEVEN KILO ALPHA ENTER	PAPA ALPHA TWO EIGHT ENTER	4. TRUE AIRSPEED 120 KTS	5. DEPARTURE POINT DELAWARE AIRPARK	ONE THREE THREE FIVE ENTER	7. CRUISING ALTITUDE 7 THOUSAND 5 HUNDRED
6. ROUTE OF FLIGHT DIRECT COYLE DIRECT PROVIDENCE					
ALPHA CHARLIE KILO ENTER		ZERO TWO FOUR FIVE ENTER	11. REMARKS ELT O.K.		
12. FUEL ON BOARD HOURS: 4 MINUTES: 30		13. ALTERNATE AIRPORT(S) BOSTON	14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE (SUBJECTS USED THEIR OWN) NANTUCKET		15. NUMBER ABOARD 2
16. COLOR OF AIRCRAFT BROWN & GOLD		CLOSE VFR FLIGHT PLAN WITH _____ FSS ON ARRIVAL			

FAA Form 7233-1 (8-77)

FIGURE 1. VFR FLIGHT PLAN NUMBER 1

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION		CIVIL AIRCRAFT PILOTS. FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed \$1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.					
<b>FLIGHT PLAN</b>							
1. AIRCRAFT IDENTIFICATION	2. AIRCRAFT TYPE	3. TRUE AIRSPEED	4. DEPARTURE POINT	5. DEPARTURE TIME		7. CRUISING ALTITUDE	
YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> ALPHA LIMA THREE ZERO FIVE ENTER	DELTA HOTEL SIX ENTER	155 KTS	PHILADELPHIA	PROPOSED (Z) ONE SEVEN FOUR FIVE ENTER	ACTUAL (Z)	6 THOUSAND 5 HUNDRED	
8. ROUTE OF FLIGHT							
KENTON DIRECT BALTIMORE DIRECT							
<input checked="" type="checkbox"/> COMPUTERIZED WORD RECOGNITION <input type="checkbox"/> TAPE RECORDED							
9. DESTINATION (SEE INSTRUCTIONS)		11. REMARKS					
PAPA TANGO BRAVO ENTER		CHARTER FLIGHT					
ZERO ONE ENTER		THREE ZERO ENTER					
12. FUEL ON BOARD		13. ALTERNATE AIRPORT(S)		14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE		15. NUMBER ABOARD	
HOURS 4	MINUTES 00	RICHMOND		(SUBJECTS USED THEIR OWN) PHILADELPHIA		12	
16. COLOR OF AIRCRAFT SILVER		17. CLOSE VFR FLIGHT PLAN WITH _____ FSS ON ARRIVAL					

FAA Form 7233-1 (5-77)

FIGURE 2. VFR FLIGHT PLAN NUMBER 2

Form Approved: OMB No. 04-R0072

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION		CIVIL AIRCRAFT PILOTS. FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed \$1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.					
FLIGHT PLAN							
1. TYPE NO. VFR	2. ROUTE ROMEO ALPHA NOVEMBER TWO SEVEN FIVE ENTER	3. ALTITUDE NOVEMBER DELTA TWO SIX SLANT ALPHA ENTER	4. DEPARTURE TIME TWO ZERO ZERO ENTER	5. ARRIVAL TIME ALPHA CHARLIE YANKEE ENTER	6. DEPARTURE TIME TWO ZERO THREE ZERO ENTER	7. CROSSING ALTITUDE FIVE THOUSAND ENTER	
CHARLIE YANKEE NOVEMBER ENTER VICTOR ONE SIX ENTER ENTER						<input checked="" type="checkbox"/> COMPUTERIZED WORD RECOGNITION  <input type="checkbox"/> TAPE RECORDED	
8. DEPARTURE TIME JULIETTE FOXTROT KILO ENTER		9. ALTITUDE ZERO ZERO FOUR FIVE ENTER		10. ARRIVAL TIME NOVEMBER OSCAR NOVEMBER ECHO ENTER			
12. FUEL ON BOARD		13. ALTERNATE AIRPORT(S)		14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE		15. NUMBER ABOARD	
HOURS 4	MINUTES 00	NEWARK		(SUBJECTS USED THEIR OWN) N. PHILADELPHIA		15	
16. COLOR OF AIRCRAFT WHITE & BLUE		CLOSE VFR FLIGHT PLAN WITH _____ FSS ON ARRIVAL					

FAA Form 7233-1 (8-77)

FIGURE 3. IFR FLIGHT PLAN NUMBER 1

Form Approved: OMB No. 04-R0072

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION <b>FLIGHT PLAN</b>		<b>CIVIL AIRCRAFT PILOTS.</b> FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed \$1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.					
NO	CLASSIFICATION	ORIGIN	DESTINATION	FLIGHT	DEPARTURE POINT	DEPARTURE TIME	REMARKS
1	NOVEMBER FOUR ONE ZERO WHISKEY BRAVO ENTER	GOLF TWO SLANT FOXTROT ENTER	FOUR FOUR ZERO ENTER	RTS	TANGO TANGO NOVEMBER ENTER	PROPOSED (Z) ZERO EIGHT FIVE ZERO ENTER	ACTUAL (Z) THREE NINER ZERO ENTER
8. ROUTE OF FLIGHT TANGO TANGO NOVEMBER TWO ENTER ROMEO INDIA CHARLIE ENTER JULIETTE FIVE TWO ENTER CHARLIE ALPHA ECHO ENTER JULIETTE SEVEN FIVE ENTER TANGO ALPHA YANKEE ENTER JULIETTE ONE ONE NINER ENTER ENTER							
9. DESTINATION (Name of airport and city)		10. ALTITUDE (Feet)		11. COMMENTS			
TANGO PAPA ALPHA ENTER		ZERO TWO TWO ZERO ENTER		ALPHA DELTA CHARLIE UNIFORM ENTER			
12. FUEL ON BOARD		13. ALTERNATE AIRPORT(S)		14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE		15. NUMBER ABOARD	
HOURS	MINUTES	ST. PETERSBURG		(SUBJECTS USED THEIR OWN) PHILADELPHIA		10	
4	00						
16. COLOR OF AIRCRAFT ORANGE & BROWN		CLOSE VFR FLIGHT PLAN WITH _____ FSS ON ARRIVAL					

FAA Form 7233-1 (8-77)

FIGURE 4. IFR FLIGHT PLAN NUMBER 2

Computer: Hello, this is the pilot automated briefing system. Detailed operating instructions are available for the new or occasional user. Do you wish detailed operating instructions? Please say yes or no immediately after the cue-tone.

User: Negative.

Computer: Say briefing, file, amend, specialist, or close.

User: File.

Computer: Standby to speak your flight plan immediately after the cue-tone. Do you wish to file a VFR flight plan? Say affirmative or negative.

User: Affirmative.

Computer: Did you say affirmative?

User: Yes.

Computer: For the following entries, use the phonetic alphabet, numbers, and the words point, slant, hundreds, thousands, and enter. All entries are terminated with the word enter. After the last element of the route of flight has been entered, say the word enter by itself to proceed with your flight plan. You must confirm all entries by saying affirmative or negative. There will be no beep-tone when the girl asks a question. Enter aircraft call sign.

User: November Seven Three Seven Kilo.

Computer: November Seven Three Seven Kilo?

User: Affirmative.

Computer: Continue.

User: Alpha Enter.

Computer: Alpha Enter?

User: Affirmative.

Computer: Enter aircraft type.

User: Papa Alpha Two Eight Enter.

Computer: Papa Alpha Two Eight Enter?

User: Yes.

Computer: Enter destination identifier.

User: Alpha Charlie Kilo Enter.

Computer: Alpha Charlie Kilo Enter?

User: Affirmative.

Computer: Enter proposed departure time.

User: One Three Three Five Enter.

Computer: One Three Three Five Enter?

User: Yes.

Computer: Enter estimated time en route.

User: Zero Two Four Five Enter.

Computer: Zero Two Four Five Enter?

User: Yes.

Computer: The following information is recorded on audio tape. Please use natural speech when you answer the question. A silence of 2 seconds, after your response, will advance you to the next question. Enter point of departure.

User: Delaware Airpark.

Computer: Enter true airspeed.

User: 120.

Computer: Enter altitude.

User: 7 thousand, 5 hundred.

Computer: Enter special equipment code.

User: Tango.

Computer: Enter route of flight.

User: Direct Coyle direct Providence.

Computer: Enter alternate airport.

User: Boston.

Computer: Enter fuel on board.

User: 4 hours and 30 minutes.

Computer: Enter number on board.

User: 2.

Computer: Enter color of aircraft.

User: Brown and gold.

Computer: Enter home base.

User: Nantucket.

Computer: Enter pilot's name, address, and telephone number.

User: Subject's name, address, and telephone number.

Computer: Enter remarks.

User: ELY O.K.

Computer: Your flight plan has been accepted and filed. Do you require additional assistance?

User: Negative.

Computer: Did you say negative?

User: Yes.

Computer: Thank you. Have a good day.

FIGURE 5. VFR PROTOCOL (VERBATIM TRANSCRIPT)

Computer: Hello, this is the pilot's automated briefing system. Detailed operating instructions are available for the new or occasional user. Do you wish detailed operating instructions? Please say yes or no immediately after the cue-tone.

User: Negative.

Computer: Say briefing, file, amend, specialist, or close.

User: File.

Computer: Standby to speak your flight plan immediately after the cue-tone. Do you wish to file a VFR flight plan? Say affirmative or negative.

User: Negative.

Computer: Did you say negative?

User: Yes.

Computer: For the following entries, use the phonetic alphabet, numbers, and the words point, slant, hundreds, thousands, and enter. All entries are terminated with the word enter. After the last element of the route of flight has been entered, say the word enter by itself to proceed with your flight plan. You must confirm all entries by saying affirmative or negative. There will be beep-tone when the girl asks a question. Enter aircraft call sign.

User: November Four One Zero Whiskey.

Computer: November Four One Zero Whiskey?

User: Affirmative.

Computer: Continue.

User: Bravo Enter.

Computer: Bravo Enter?

User: Yes.

Computer: Enter aircraft type and special equipment code.

User: Golf Two Slant Foxtrot Enter.

Computer: Golf Two Slant Foxtrot Enter?

User: Yes.

Computer: Enter destination identifier.

User: Tango Papa Alpha Enter.

Computer: Tango Papa Alpha Enter?

User: Yes.

Computer: Enter proposed departure time.

User: Zero Eight Five Zero Enter.

Computer: Zero Eight Five Zero Enter?

User: Yes.

Computer: Enter estimated time en route.

User: Zero Two Two Zero Enter.

Computer: Zero Two Two Zero Enter?

User: Yes.

Computer: Enter true airspeed.

User: Four Four Zero Enter.

Computer: Four Four Zero Enter?

User: Yes.

Computer: Enter departure identifier.

User: Tango Tango November Enter.

Computer: Tango-Tango-November Enter?

User: Yes.

Computer: Enter proposed altitude.

Computer: Enter next route element.

User: Romeo India Charlie Enter.

Computer: Romeo India Charlie Enter?

User: Yes.

Computer: Enter next route element.

User: Juliette Five Two Enter.

Computer: Juliette Five Two Enter?

User: Affirmative.

Computer: Enter next route element.

User: Charlie Alpha Echo Enter.

Computer: Charlie Alpha Echo Enter?

User: Yes.

Computer: Enter next route element.

User: Juliette Seven Five Enter.

Computer: Juliette Seven North Enter?

User: Negative.

Computer: Sorry — try again.

User: Juliette Seven Five Enter.

Computer: Juliette Seven Five Enter?

User: Yes.

Computer: Enter next route element.

User: Tango Alpha Yankee Enter.

Computer: Tango Alpha Yankee Enter?

User: Yes.

Computer: Enter next route element.

User: Juliette One One Niner Enter.

Computer: Juliette One One Niner Enter?

User: Yes.

Computer: Enter next route element.

User: Enter.

Computer: Enter?

User: Yes.

Computer: Enter remarks.

User: Alpha Delta Charlie Uniform Enter.

Computer: Alpha Delta Charlie Uniform Enter?

User: Affirmative.

Computer: The following information is recorded on aud speech when you answer the question. A silent response, will advance you to the next question.

User: St. Petersburg.

Computer: Enter fuel on board.

User: 4 hours.

Computer: Enter number on board.

User: 10.

Computer: Enter color of aircraft.

User: Orange and brown.

Computer: Enter home base.

Instructions are available for the new or occasional user. Do you want detailed operating instructions? Please say yes or no immediately after the cue-tone.

User: Negative.

Computer: Say briefing, file, amend, specialist, or close.

User: File.

Computer: Standby to speak your flight plan immediately after the cue-tone. Do you wish to file a VFR flight plan? Say affirmative or negative.

User: Negative.

Computer: Did you say negative?

User: Yes.

Computer: For the following entries, use the phonetic alphabet, numbers, and the words point, slant, hundreds, thousands, and enter. All entries are terminated with the word enter. After the last element of the route of flight has been entered, say the word enter by itself to proceed with your flight plan. You must confirm all entries by saying affirmative or negative. There will be beep-tone when the girl asks a question. Enter aircraft call sign.

User: November Four One Zero Whiskey.

Computer: November Four One Zero Whiskey?

User: Affirmative.

Computer: Continue.

User: Bravo Enter.

Computer: Bravo Enter?

User: Yes.

Computer: Enter aircraft type and special equipment code.

User: Golf Two Slant Foxrot Enter.

Computer: Golf Two Slant Foxrot Enter?

User: Yes.

Computer: Enter destination identifier.

User: Tango Papa Alpha Enter.

Computer: Tango Papa Alpha Enter?

User: Yes.

Computer: Enter proposed departure time.

User: Zero Eight Five Zero Enter.

Computer: Zero Eight Five Zero Enter?

User: Yes.

Computer: Enter estimated time en route.

User: Zero Two Two Zero Enter.

Computer: Zero Two Two Zero Enter?

User: Yes.

Computer: Enter true airspeed.

User: Four Four Zero Enter.

Computer: Four Four Zero Enter?

User: Yes.

Computer: Enter departure identifier.

User: Tango Tango November Enter.

Computer: Tango Tango November Enter?

User: Yes.

Computer: Enter proposed altitude.

User: Three Niner Zero Enter.

Computer: Three Niner Zero Enter?

User: Yes.

Computer: There is no preferred route for your entry? Enter first route element.

User: Tango Tango November Two Enter.

Computer: Tango Tango November Two Enter?

User: Yes.

User: Romeo India Charlie Enter.

Computer: Romeo India Charlie Enter?

User: Yes.

Computer: Enter next route element.

User: Juliette Five Two Enter.

Computer: Juliette Five Two Enter?

User: Affirmative.

Computer: Enter next route element.

User: Charlie Alpha Echo Enter.

Computer: Charlie Alpha Echo Enter?

User: Yes.

Computer: Enter next route element.

User: Juliette Seven Five Enter.

Computer: Juliette Seven North Enter?

User: Negative.

Computer: Sorry — try again.

User: Juliette Seven Five Enter.

Computer: Juliette Seven Five Enter?

User: Yes.

Computer: Enter next route element.

User: Tango Alpha Yankee Enter.

Computer: Tango Alpha Yankee Enter?

User: Yes.

Computer: Enter next route element.

User: Juliette One One Niner Enter.

Computer: Juliette One One Niner Enter?

User: Yes.

Computer: Enter next route element.

User: Enter.

Computer: Enter?

User: Yes.

Computer: Enter remarks.

User: Alpha Delta Charlie Uniform Enter.

Computer: Alpha Delta Charlie Uniform Enter?

User: Affirmative.

Computer: The following information is recorded on audio tape. Please use natural speech when you answer the question. A silence of 2 seconds, after your response, will advance you to the next question. Enter alternate airport.

User: St. Petersburg.

Computer: Enter fuel on board.

User: 4 hours.

Computer: Enter number on board.

User: 10.

Computer: Enter color of aircraft.

User: Orange and brown.

Computer: Enter home base.

User: Philadelphia.

Computer: Enter pilot's name, address, and telephone number.

User: Subject's name, address, and telephone number.

Computer: Your flight plan has been accepted and filed. Do you require additional assistance?

User: Negative.

Computer: Thank you. Have a good day.

FIGURE 6. IFR PROTOCOL (VERBATIM TRANSCRIPT)

2



## RESULTS

### INITIAL TESTS.

Table 2 summarizes the results of the initial test. The numbers in column 2, Total Words Spoken, are the total number of words spoken by the subject in entering all four flight plans. Column 3, Please Repeat, shows the number and percentage of utterances that were unrecognized by the computer. This occurred when the computer could not make an identification and therefore asked for a repeat speech sample. Column 4 reflects the number and percentage of misrecognized words. Not all unrecognized and misrecognized words were due to system error. A significant amount were a result of user errors, such as speaking words that were not in the vocabulary data base, speaking two or more words at a time, not confirming an entry with a "yes" or a "no," speaking before the cue-tone, etc. Nevertheless, the majority of misrecognitions were the result of system error. Column 5 shows the accuracy of the flight plans as finally completed after corrections. The percent of accuracy was determined by dividing the number of words recognized correctly by the number of words in the flight plans. As reflected in Column 5, ten out of the fifteen subjects were able to file flight plans (two VFR and two IFR) that were 100 percent accurate. The flight plan accuracy attained by the other five subjects ranged from 93.2 to 99.4 percent. The total number of words spoken by the subjects shown in Column 2 exceeds the number of words in the flight plans as shown in Column 5. The reason for this is that each entry must be confirmed with a "yes" or a "no" (affirmative or negative). It is important to note that the overall accuracy after corrections for all of the flight plans combined was 99 percent.

Tables 3 through 17 show the results obtained by each subject for each flight plan. The subject numbers correspond to the numbers shown in table 2, Summary of Initial Test Results.

Table 18 shows the time taken for each subject to complete each of the four flight plans. It should be pointed out, however, that the time necessary to complete a flight plan could be substantially reduced by shortening the interval between cue-tones and prompts, and by eliminating the long explanatory message.

Table 19 identifies the words that were misrecognized more than once. These are listed in column 1. Column 2 shows the words they (the misrecognized words in column 1) were confused with. Column 3 lists the number of times the words were confused. Column 4 identifies the speaker (by number) of the misrecognized word. The speaker numbers shown in column 4 correspond to the subject numbers in table 2.

As shown in table 19, the system misrecognized the word "affirmative" and confused it with "negative" seven times. The word "negative" was misrecognized and confused with "affirmative" five times. The "ative" sound patterns are nearly identical in both words. "Yes" was misrecognized and confused with "no" six times, while "no" was confused with "yes" twice. There are methods, however, for reducing this type of confusion, especially when there are only four possible words expected.

As reflected in table 19, the word "eight" was confused with six other words. "Eight" is a confusable word with all recognition techniques. It is a low energy word, especially if spoken without a clear "t" plosive sound at the end. The word "enter" was also confused with a number of words; particularly with the word

"attention." Five different speakers confused it with "attention" eight times. The test results showed that "enter" was recognized much more readily when the "t" was given a little emphasis. The word "five" was confused with "Mike" five times by three speakers. The "five"/"Mike" confusion is a common one and will be difficult to overcome. The "November" confusions suggest that something is wrong with the "November" reference pattern. This can probably be corrected. It can be seen from examining column 4 of table 19 that subject number 13 and 15 contributed a disproportionate number of misrecognitions.

The confusion between "affirmative" and "negative" or between "yes" and "no" often led to a chain reaction of other errors due to the nature of the correction routine. If "yes" was confused with "no," the correct word was temporarily eliminated from the vocabulary thus causing a series of other mistakes. The excerpt below, from an actual transaction, will illustrate this problem. Because "yes" was confused with "no," the correct word "November" was temporarily eliminated from the vocabulary. The system then made the next best choice from a set of word patterns that did not include the pattern for November. Thus, further errors occurred until the completion of the correction cycle, at which time the pattern for November was reentered in the vocabulary.

Computer: Enter aircraft call sign.  
User : Romeo Alpha November Two Seven.  
Computer: Romeo Alpha November Two Attention?  
User : No.  
Computer: Sorry! Try again.  
User : Romeo Alpha November Two Seven.  
Computer: Romeo Alpha November Two Attention?  
User : No.  
Computer: I'm sorry! Was your first word Romeo?  
User : Yes.  
Computer: Was the next Alpha?  
User : Yes.  
Computer: Was the next November?  
User : Yes.  
Computer: What was it?  
User : November.  
Computer: Did you say Hotel?  
User : No.  
Computer: What did you say?  
User : November.  
Computer: Did you say Lima?  
User : No.  
Computer: Enter aircraft call sign.  
User : Romeo Alpha November Two Seven.  
Computer: Romeo Alpha November Two X-ray?  
User : No.  
Computer: Sorry! Try again.  
User : Romeo Alpha November Two Seven.  
Computer: Romeo Alpha November Two Seven?  
User : Yes.  
Computer: Continue.

TABLE 2. SUMMARY OF INITIAL TEST RESULTS

	Total Words Spoken	Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections	
	No.	No.	Percent	No.	Percent	No. of Words Correct/ No. of Words in FP	Percent
1. Experienced	242	1	0.41	1	0.41	177/177	100
2. Inexperienced	247	2	0.81	0	0.00	177/177	100
3. Inexperienced	266	2	0.75	5	1.88	177/177	100
4. Inexperienced	271	1	0.37	8	2.95	177/177	100
5. Inexperienced	265	5	1.89	6	2.26	177/177	100
6. Inexperienced	274	3	1.09	9	3.28	177/177	100
7. Inexperienced	291	1	0.34	13	4.47	177/177	100
8. Inexperienced	279	3	1.08	11	3.94	176/177	99.44
9. Inexperienced	308	1	0.32	17	5.52	174/174	100
10. Inexperienced	330	4	1.21	20	6.06	177/177	100
11. Inexperienced	328	8	2.44	18	5.49	177/177	100
12. Inexperienced	318	4	1.26	25	7.86	169/177	95.48
13. Inexperienced	351	5	1.42	29	8.26	175/177	98.87
14. Inexperienced	357	8	2.24	33	9.24	175/177	98.87
15. Inexperienced	<u>347</u>	<u>13</u>	<u>3.75</u>	<u>31</u>	<u>8.93</u>	<u>165/177</u>	<u>93.22</u>
Totals	4,474	61	1.36	226	5.05	2627/2652	99.06

TABLE 3. SUBJECT NUMBER 1 (EXPERIENCED USER)

Flight Plan	Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		Time Min:Sec
	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent		
VFR-1	37	0	0.00	0	0.00	26/26	100	4:12	
VFR-2	34	0	0.00	0	0.00	24/24	100	4:04	
IFR-1	77	1	1.30	1	1.30	53/53	100	6:01	
IFR-2	94	0	0.00	0	0.00	74/74	100	7:27	
Total	242	1	0.41	1	0.41	177/177	100	--	

TABLE 4. SUBJECT NUMBER 2 (INEXPERIENCED USER)

Flight Plan	Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		Time Min:Sec
	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent		
VFR-1	38	0	0.00	0	0.00	26/26	100	4:29	
VFR-2	35	0	0.00	0	0.00	24/24	100	4:12	
IFR-1	72	1	1.39	0	0.00	53/53	100	5:51	
IFR-2	<u>102</u>	<u>1</u>	<u>0.98</u>	<u>0</u>	<u>0.00</u>	<u>74/74</u>	<u>100</u>	<u>6:58</u>	
Total	247	2	0.81	0	0.00	177/177	100	--	

TABLE 5. SUBJECT NUMBER 3 (INEXPERIENCED USER)

	Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		
Flight Plan	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent	Time Min:Sec	
VFR-1	53	1	1.89	3	5.66	26/26	100	5:09	
VFR-2	37	0	0.00	0	0.00	24/24	100	4:09	
IFR-1	82	1	1.22	2	2.44	53/53	100	5:56	
IFR-2	<u>94</u>	<u>0</u>	<u>0.00</u>	<u>0</u>	<u>0.00</u>	<u>74/74</u>	<u>100</u>	<u>8:29</u>	
Total	266	2	0.75	5	1.88	177/177	100	--	

TABLE 6. SUBJECT NUMBER 4 (INEXPERIENCED USER)

Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		
Flight Plan	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent	Time Min:Sec
VFR-1	45	0	0.00	2	4.44	26/26	100	4:42
VFR-2	39	1	2.56	1	2.56	24/24	100	4:32
IFR-1	70	0	0.00	0	0.00	53/53	100	5:39
IFR-2	<u>117</u>	<u>0</u>	<u>0.00</u>	<u>5</u>	<u>4.27</u>	<u>74/74</u>	<u>100</u>	<u>8:18</u>
Total	271	1	0.37	8	2.95	177/177	100	—

TABLE 7. SUBJECT NUMBER 5 (INEXPERIENCED USER)

Flight Plan	Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		Time Min:Sec
	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent		
VFR-1	49	2	4.08	2	4.08	26/26	100	5:09	
VFR-2	32	0	0.00	0	0.00	24/24	100	4:19	
IFR-1	83	2	2.41	3	3.61	53/53	100	6:38	
IFR-2	<u>101</u>	<u>1</u>	<u>0.99</u>	<u>1</u>	<u>0.99</u>	<u>74/74</u>	<u>100</u>	<u>7:30</u>	
Total	265	5	1.89	6	2.26	177/177	100	--	



TABLE 8. SUBJECT NUMBER 6 (INEXPERIENCED USER)

	Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		
Flight Plan	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP		Time Min:Sec	
VFR-1	37	0	0.00	0	0.00	26/26		4:27	
VFR-2	35	1	2.86	1	2.86	24/24		4:38	
IFR-1	86	1	1.16	3	3.49	53/53		7:08	
IFR-2	<u>116</u>	<u>1</u>	<u>0.86</u>	<u>5</u>	<u>4.31</u>	<u>74/74</u>		<u>8:53</u>	
Total	274	3	1.09	9	3.28	177/177		--	

TABLE 9. SUBJECT NUMBER 7 (INEXPERIENCED USER)

Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		
Flight Plan	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent	Time Min:Sec
VFR-1	55	0	0.00	3	5.45	26/26	100	5:08
VFR-2	37	0	0.00	3	8.11	24/24	100	4:23
IFR-1	74	0	0.00	1	1.35	53/53	100	5:39
IFR-2	<u>125</u>	<u>1</u>	<u>0.80</u>	<u>6</u>	<u>4.80</u>	<u>74/74</u>	<u>100</u>	<u>8:17</u>
Total	291	1	0.34	13	4.47	177/177	100	--

TABLE 10. SUBJECT NUMBER 8 (INEXPERIENCED USER)

Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		
Flight Plan	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent	Time Min:Sec
VFR-1	45	1	2.22	1	2.22	26/26	100	4:49
VFR-2	41	1	2.44	1	2.44	24/24	100	4:50
IFR-1	87	0	0.00	7	8.05	53/53	100	6:52
IFR-2	<u>106</u>	<u>1</u>	<u>0.94</u>	<u>2</u>	<u>1.89</u>	<u>73/74</u>	<u>98.65</u>	<u>7:57</u>
Total	279	3	1.08	11	3.94	176/177	99.44	—

TABLE 11. SUBJECT NUMBER 9 (INEXPERIENCED USER)

Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		
Flight Plan	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent	Time Min:Sec
VFR-1	51	0	0.00	2	3.92	26/26	100	4:54
VFR-2	40	0	0.00	1	2.50	24/24	100	4:22
IFR-1	105	0	0.00	9	8.57	53/53	100	7:25
IFR-2	<u>112</u>	<u>1</u>	<u>0.89</u>	<u>5</u>	<u>4.46</u>	<u>71/71</u>	<u>100</u>	<u>8:22</u>
Total	308	1	0.32	17	5.52	174/174	100	--

TABLE 12. SUBJECT NUMBER 10 (INEXPERIENCED USER)

Flight Plan	Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		Time Min:Sec
	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent		
VFR-1	51	2	3.92	2	3.92	26/26	100	5:31	
VFR-2	40	0	0.00	2	5.00	24/24	100	4:39	
IFR-1	128	0	0.00	14	10.94	53/53	100	9:17	
IFR-2	<u>111</u>	<u>2</u>	<u>1.80</u>	<u>2</u>	<u>1.80</u>	<u>74/74</u>	<u>100</u>	<u>7:53</u>	
Total	330	4	1.21	20	6.06	177/177	100	--	

TABLE 13. SUBJECT NUMBER 11 (INEXPERIENCED USER)

Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		
Flight Plan	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent	Time Min:Sec
VFR-1	47	1	2.13	1	2.13	26/26	100	5:24
VFR-2	47	2	4.26	2	4.26	24/24	100	5:08
IFR-1	116	3	2.59	11	9.48	53/53	100	8:14
IFR-2	<u>118</u>	<u>2</u>	<u>1.69</u>	<u>4</u>	<u>3.39</u>	<u>74/74</u>	<u>100</u>	<u>8:44</u>
Total	328	8	2.44	18	5.49	177/177	100	--

TABLE 14. SUBJECT NUMBER 12 (INEXPERIENCED USER)

Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		
Flight Plan	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent	Time Min:Sec
VFR-1	68	1	1.47	7	10.29	26/26	100	5:41
VFR-2	36	3	8.33	5	13.89	21/24	87.50	4:30
IFR-1	105	0	0.00	8	7.62	52/53	98.11	7:30
IFR-2	<u>109</u>	<u>0</u>	<u>0.00</u>	<u>5</u>	<u>4.59</u>	<u>70/74</u>	<u>94.59</u>	<u>7:45</u>
Total	318	4	1.26	25	7.86	169/177	95.48	--

TABLE 15. SUBJECT NUMBER 13 (INEXPERIENCED USER)

	Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections	
Flight Plan	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent	Time Min:Sec
VFR-1	79	2	2.53	11	13.92	26/26	100	6:49
VFR-2	54	1	1.85	7	12.96	23/24	95.83	5:15
IFR-1	72	0	0.00	1	1.39	53/53	100	5:42
IFR-2	<u>146</u>	<u>2</u>	<u>1.37</u>	<u>10</u>	<u>6.85</u>	<u>73/74</u>	<u>98.65</u>	<u>9:50</u>
Total	351	5	1.42	29	8.26	175/177	98.87	--



TABLE 16. SUBJECT NUMBER 14 (INEXPERIENCED USER)

Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		
Flight Plan	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent	Time Min:Sec
VFR-1	77	2	2.60	10	12.99	26/26	100	7:03
VFR-2	40	1	2.50	1	2.50	24/24	100	4:31
IFR-1	94	0	0.00	7	7.45	52/53	98.11	7:13
IFR-2	<u>146</u>	<u>5</u>	<u>3.42</u>	<u>15</u>	<u>10.27</u>	<u>73/74</u>	<u>98.65</u>	<u>10:15</u>
Total	357	8	2.24	33	9.24	175/177	98.87	--

TABLE 17. SUBJECT NUMBER 15 (INEXPERIENCED USER)

	Total Words Spoken		Please Repeat		Misrecognized Words		Accuracy of Flight Plans After Corrections		
Flight Plan	No.	No.	Percent	No.	Percent	Percent of Words Correct/ No. of Words in FP	Percent	Time Min:Sec	
VFR-1	69	7	10.14	17	24.64	19/26	73.08	6:52	
VFR-2	34	1	2.94	0	0.00	23/24	95.83	4:44	
IFR-1	115	3	2.61	7	6.09	53/53	100	5:11	
IFR-2	<u>129</u>	<u>2</u>	<u>1.55</u>	<u>7</u>	<u>5.43</u>	<u>70/74</u>	<u>94.59</u>	<u>10:10</u>	
Total	347	13	3.75	31	8.93	165/177	93.22	--	

TABLE 18. TIME TAKEN TO COMPLETE FLIGHT PLANS

<u>User</u>	<u>VFR-1 (min:sec)</u>	<u>VFR-2 (min:sec)</u>	<u>IFR-1 (min:sec)</u>	<u>IFR-2 (min:sec)</u>
1. Experienced	4:12	4:04	6:01	7:27
2. Inexperienced	4:29	4:12	5:51	6:58
3. Inexperienced	5:09	4:09	5:56	8:29
4. Inexperienced	4:42	4:32	5:39	8:18
5. Inexperienced	5:09	4:19	6:38	7:30
6. Inexperienced	4:27	4:38	7:08	8:53
7. Inexperienced	5:08	4:23	5:39	8:17
8. Inexperienced	4:49	4:50	6:52	7:57
9. Inexperienced	4:54	4:22	7:25	8:22
10. Inexperienced	5:31	4:39	9:17	7:53
11. Inexperienced	5:24	5:08	8:14	8:44
12. Inexperienced	5:41	4:30	7:30	7:45
13. Inexperienced	6:49	5:15	5:42	9:50
14. Inexperienced	7:03	4:31	7:13	10:15
15. Inexperienced	<u>6:52</u>	<u>4:44</u>	<u>9:11</u>	<u>10:10</u>
Average Time	5:21	4:33	6:57	8:27

TABLE 19. WORDS MISRECOGNIZED MORE THAN ONCE

Words Misrecognized More Than Once	Confused With	No. of Times	Speaker No.
Affirmative	Negative	7	8, 11, 14, 13
Affirmative	X-ray	2	14
Alpha	Delta	1	13
Alpha	Papa	2	15
Alpha	Uniform	1	8
Alpha	Whiskey	1	11
Alpha	X-ray	2	11
Alpha	Six	1	14
Alpha	Hundred	1	14
Bravo	Lima	2	6
Bravo	Papa	1	6
Delta	Alpha	4	15
Delta	Thousand	1	6
Echo	Hotel	1	10
Echo	Kilo	1	10
Echo	Tango	1	4
Eight	Enter	1	13
Eight	Juliette	2	13
Eight	Lima	2	14
Eight	Victor	8	4, 7, 14, 13
Eight	Yankee	1	8
Eight	Six	5	7, 6
Enter	Attention	8	4, 7, 9, 11, 6
Enter	Alpha	2	4, 7
Enter	Echo	1	15
Enter	November	2	9
Enter	Papa	1	7
Enter	Tango	2	9, 14
Enter	Uniform	2	7, 8
Enter	Victor	5	9, 13, 15
Enter	X-ray	1	14
Enter	Six	1	2
Enter	Seven	1	13
File	Specialist	1	13
Five	Echo	1	14
Five	Foxtrot	2	8, 2
Five	Hotel	1	2
Five	Mike	5	2, 12, 11
Five	Nine	1	7
Five	Oscar	1	12
Five	Point	1	8
Five	Victor	2	13, 15
Five	Whiskey	1	12
Five	One	3	4, 12
Five	Four	1	11
Five	Nine	1	4
Four	Tango	1	8
Four	Victor	1	11
Juliette	India	1	14
Juliette	Slant	2	14
Juliette	Uniform	1	15
Juliette	Three	1	7
Juliette	Nine	1	11
Kilo	Zero	2	2
Kilo	Hundred	1	14
Negative	Affirmative	5	9, 14, 15
Negative	Affirmative	2	6, 13
November	Attention	1	3
November	Echo	1	8
November	Enter	1	2
November	Hotel	1	9
November	Kilo	1	3
November	Lima	1	9
November	Uniform	6	10, 15
November	Victor	2	11, 14
November	Victor	2	10, 11, 14

Enter	Alpha	2	4, 7
Enter	Echo	1	15
Enter	November	2	9
Enter	Papa	1	7
Enter	Tango	2	9, 14
Enter	Uniform	2	7, 8
Enter	Victor	5	9, 13, 15
Enter	X-ray	1	14
Enter	Six	1	2
Enter	Seven	1	13
File	Specialist	1	13
Five	Echo	1	14
Five	Foxtrot	2	8, 2
Five	Hotel	1	2
Five	Mike	5	2, 12, 11
Five	Nine	1	7
Five	Oscar	1	12
Five	Point	1	8
Five	Victor	2	13, 15
Five	Whiskey	1	12
Five	One	3	4, 12
Five	Four	1	11
Five	Nine	1	4
Four	Tango	1	8
Four	Victor	1	11
Juliette	India	1	14
Juliette	Slant	2	14
Juliette	Uniform	1	15
Juliette	Three	1	7
Juliette	Nine	1	11
Kilo	Zero	2	2
Kilo	Hundred	1	14
Negative	Affirmative	5	9, 14, 15
Negative	Affirmative	2	6, 13
November	Attention	1	3
November	Echo	1	8
November	Enter	1	2
November	Hotel	1	9
November	Kilo	1	3
November	Lima	1	9
November	Uniform	6	10, 15
November	Victor	2	11, 14
November	X-ray	5	10, 11, 14
One	Nine	1	6
One	Hundred	1	14
Papa	Bravo	1	2
Papa	Oscar	1	14
Papa	X-ray	2	11, 15
Seven	Attention	2	9
Seven	Kilo	3	12
Seven	Lima	3	13
Seven	November	1	13
Seven	Uniform	7	12, 11
Seven	X-ray	2	10
Seven	Three	1	14
Seven	Hundred	1	7
Tango	Echo	2	14, 15
Tango	Kilo	1	9
Tango	X-ray	1	14
Two	Delta	1	8
Two	Echo	2	12, 3
Two	November	1	15
Two	Tango	1	3
Two	X-ray	1	15
Two	Zulu	4	15
Two	Zero	1	13
Victor	Echo	2	10, 14
Victor	Quebec	1	15
Victor	Sierra	1	10
Victor	Uniform	3	10
Victor	X-ray	1	10
Victor	Six	1	10
Victor	Niner	1	3
Affirmative	Negative	6	11, 12, 13, 15
Zero	Sierra	4	9, 6, 13
Zero	Victor	1	8

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#### COMPUTER VOICE.

The system communicated with the user through stored human speech. The users found the voice to be friendly, polite, and assuring. It should be remembered that recognition failure can cause the user to become frustrated and to lose confidence in the system. If the voice used by the system can reduce frustration, then it seems advisable to provide user-friendly dialogue.

#### COMPARISON OF OLD AND NEW REFERENCE PATTERNS.

The old data base consisted of 500 voices saying the digits, the words "yes" and "no," and 300 voices saying the other words. No attempt was made to build the capability to handle variations in pronunciation due to speaker dialects into the recognition algorithm. On the other hand, the new data base included the broad range of dialectal variation, as pointed out by the dialect study. Thus, the new recognition algorithm was constructed from a larger, more universal, and organized data base. Tables 20 through 23 compare the results of entering a test set of 200 voices as entered against the old and new reference patterns. It is important to note that this test set of 200 voices was not used in the construction of reference patterns, and was selected across recorded dialects. Since the test set included a broad range of American dialectal variation, it was considered to be a reliable gauge for estimating how well the system might perform on a nationwide basis. In each confusion matrix, the test set is represented by the vertical column and the data base by the horizontal. The figures in the matrix represent the percentage of correct recognitions to one-tenth of one percent; i.e., 926 is 92.6 percent.

Examination of tables 20 through 23, shows the following results:

	<u>Old Data Base</u>	<u>New Data Base</u>
North, South, East, West, Local	91.28%	97.23%
File, Specialist, Briefing, Amend, Close	92.15%	96.48%
Affirmative, Negative, Yes, No	98.55%	97.94%
Zero through Nine, Yes, No	92.28%	94.03%

With the exception of the subset (affirmative, negative, yes, no), the new reference patterns recorded a notable increase in recognition accuracy over the old patterns. The use of a linguistically more complete data base in the new system also promotes the probability that it is better adapted to a wider representation of the United States population. Upon closer inspection of table 22, we find that there is a reduction in accuracy of 1.1 percent for the words "yes" and "no" in the new data base as compared to the old. This indicates a need to reexamine the reference pattern for these words.

Nevertheless, it would be reasonable to assume, judging from tables 20 through 23, that the improvements in accuracy, with the new data base, would raise the performance of the Mass Weather Dissemination Engineering Model to a level quite satisfactory for the general pilot population. In this model, only the following three active vocabularies would be used:

1. "North, South, East, West, and Local" (97.2 percent accurate)
2. "Yes, No, Affirmative, and Negative" (97.9 percent accurate)
3. "File, Briefing, Specialist, Close, and Amend" (96.5 percent accurate)

Tables 24 and 25 show the recognition accuracy of the words in the phonetic alphabet as they might be used in larger groups. While the overall accuracy is good, some of the words have relatively high confusion rates, such as "zero" and "kilo" as shown in table 25. It also appears that "enter" may not be the best choice for a terminator since it has an appreciable correlation with almost all the words in table 25 (see last column). Other terminators, such as the word "stop" or the use of silence might produce better results.

TABLE 20. COMPARISON BETWEEN OLD AND NEW REFERENCE PATTERNS  
FOR DIRECTION CONTROL WORDS

Old					
	<u>North</u>	<u>South</u>	<u>East</u>	<u>West</u>	<u>Local</u>
North	926	5	22	5	39
South	22	778	79	0	119
East	23	0	960	0	15
West	11	0	23	959	5
Local	29	5	11	0	853

91.28% recognized as correct word.

New					
	<u>North</u>	<u>South</u>	<u>East</u>	<u>West</u>	<u>Local</u>
North	952	5	23	0	17
South	5	970	5	0	17
East	0	8	983	0	8
West	5	0	23	970	0
Local	6	0	6	0	987

97.23% recognized as correct word.



TABLE 21. COMPARISON BETWEEN OLD AND NEW REFERENCE PATTERNS  
(FILE, SPECIALIST, BRIEFING, AMEND, CLOSE)

	Old				
	<u>File</u>	<u>Specialist</u>	<u>Briefing</u>	<u>Amend</u>	<u>Close</u>
File	964	17	0	5	11
Specialist	0	947	35	0	17
Briefing	0	11	938	28	22
Amend	0	101	0	790	107
Close	16	5	5	11	961

92.15% recognized as correct word.

	New				
	<u>File</u>	<u>Briefing</u>	<u>Specialist</u>	<u>Close</u>	<u>Amend</u>
File	987	6	0	6	0
Briefing	0	940	5	11	41
Specialist	0	6	969	12	12
Close	11	11	0	965	11
Amend	0	12	12	12	962

96.48% recognized as correct word.

TABLE 22. COMPARISON BETWEEN OLD AND NEW REFERENCE PATTERNS  
(YES, NO, AFFIRMATIVE, NEGATIVE)

Old				
	<u>No</u>	<u>Yes</u>	<u>Affirmative</u>	<u>Negative</u>
No	982	0	11	5
Yes	11	988	0	0
Affirmative	0	0	988	11
Negative	0	0	17	982

98.55% recognized as correct word.

New				
	<u>Yes</u>	<u>No</u>	<u>Affirmative</u>	<u>Negative</u>
Yes	977	0	5	17
No	0	971	28	0
Affirmative	0	0	981	18
Negative	0	0	12	987

97.94% recognized as correct word.

TABLE 23. COMPARISON BETWEEN OLD AND NEW REFERENCE PATTERNS  
(DIGITS ZERO THROUGH NINE, PLUS YES AND NO)

Old												
	<u>Zero</u>	<u>One</u>	<u>Two</u>	<u>Three</u>	<u>Four</u>	<u>Five</u>	<u>Six</u>	<u>Seven</u>	<u>Eight</u>	<u>Nine</u>	<u>No</u>	<u>Yes</u>
Zero	920	0	11	0	11	0	0	16	0	11	16	11
One	0	955	0	0	5	11	0	0	0	0	0	27
Two	16	0	950	0	5	0	5	16	0	0	5	0
Three	0	0	11	971	5	0	0	0	0	11	0	0
Four	5	22	5	0	954	0	0	0	5	0	0	5
Five	0	29	0	0	11	911	5	23	5	11	0	0
Six	0	0	0	0	0	0	977	0	16	5	0	0
Seven	11	0	16	5	22	5	5	906	11	0	5	11
Eight	0	0	5	11	11	0	93	0	853	5	5	11
Nine	0	17	0	34	0	98	5	17	0	826	0	0
No	22	0	5	5	11	0	0	22	0	11	920	0
Yes	11	0	0	0	5	0	5	23	23	0	11	918

92.28% recognized as correct word.

New												
	<u>Zero</u>	<u>One</u>	<u>Two</u>	<u>Three</u>	<u>Four</u>	<u>Five</u>	<u>Six</u>	<u>Seven</u>	<u>Eight</u>	<u>Nine</u>	<u>No</u>	<u>Yes</u>
Zero	971	0	5	0	11	0	0	0	0	0	5	5
One	0	956	0	0	10	10	0	0	10	0	0	10
Two	16	0	960	0	0	0	5	5	0	3	5	0
Three	0	0	0	954	0	5	16	0	5	16	0	0
Four	0	0	0	11	971	0	5	5	5	0	0	0
Five	0	11	0	0	0	890	5	17	0	75	0	0
Six	0	0	0	0	5	5	927	27	22	11	0	0
Seven	10	0	5	0	10	3	32	906	0	10	0	16
Eight	0	0	5	17	11	0	28	0	920	11	0	5
Nine	0	0	0	5	0	46	0	5	0	942	0	0
No	5	0	0	0	5	0	0	22	0	3	960	0
Yes	17	5	11	0	5	0	17	11	5	0	0	926

94.03% recognized as correct word.

TABLE 24. CONFUSION MATRIX FOR PHONETIC A

	<u>Zula</u>	<u>Quebec</u>	<u>India</u>	<u>Char</u>	<u>Bravo</u>	<u>Tango</u>	<u>Juli</u>	<u>Unif</u>	<u>Romeo</u>	<u>Alpha</u>	<u>Papa</u>	<u>Whis</u>	<u>Delta</u>	<u>Xray</u>	<u>Mike</u>
Zula	936	0	12	0	0	4	0	4	0	0	0	0	0	4	0
Quebec	0	872	3	0	0	7	19	0	0	0	0	31	0	27	3
India	16	8	904	0	0	0	12	8	0	0	0	0	0	4	0
Charlie	0	0	0	964	3	0	0	3	7	0	0	0	0	0	7
Bravo	0	0	0	0	936	0	3	0	3	0	19	0	0	0	0
Tango	0	0	7	0	3	848	0	7	0	0	0	3	0	7	0
Juliet	16	20	44	0	0	4	886	4	0	0	0	4	0	0	0
Uniform	4	8	20	0	0	12	4	913	0	0	0	0	0	0	4
Romeo	0	4	4	0	0	4	0	0	906	0	0	16	0	4	0
Alpha	0	0	0	0	3	7	0	3	0	844	38	0	15	3	0
Papa	0	0	3	3	11	3	0	7	0	11	906	0	0	11	0
Whiskey	0	12	0	0	0	4	4	4	0	0	0	946	0	8	0
Delta	3	0	3	0	0	0	3	7	0	3	0	0	890	7	0
Xray	0	0	8	0	0	4	0	8	0	0	4	8	4	931	0
Mike	0	0	0	3	0	0	0	0	0	0	0	15	0	3	940
November	20	4	12	0	0	4	12	4	4	0	0	0	0	4	4
Victor	8	0	12	0	0	4	0	28	4	0	0	24	0	16	0
Foxtrot	0	0	0	3	0	0	0	3	0	0	3	0	0	7	0
Yankee	4	0	16	0	8	12	8	4	4	0	0	8	0	0	0
Echo	7	0	3	0	0	50	0	19	0	3	3	0	0	7	0
Golf	3	7	0	0	0	3	0	0	0	0	3	0	0	0	0
Kilo	12	4	16	0	8	24	0	0	4	0	0	0	4	4	0
Hotel	4	8	0	4	0	8	0	8	4	0	0	0	0	16	0
Sierra	0	0	16	0	0	8	0	4	0	0	0	0	0	0	0
Oscar	0	0	0	0	0	0	0	0	0	0	4	4	0	8	0
Lima	4	0	4	0	0	12	4	37	16	0	4	20	0	4	12

90.10% recognized as correct word.

# CONFUSION MATRIX FOR PHONETIC ALPHABET

<u>Papa</u>	<u>Whia</u>	<u>Delta</u>	<u>Xray</u>	<u>Mike</u>	<u>Novo</u>	<u>Vict</u>	<u>Foxt</u>	<u>Yank</u>	<u>Echo</u>	<u>Golf</u>	<u>Kilo</u>	<u>Hotel</u>	<u>Sier</u>	<u>Oscar</u>	<u>Lima</u>
0	0	0	4	0	0	8	0	0	0	0	16	0	0	0	12
0	31	0	27	3	0	11	0	0	0	15	0	0	0	0	3
0	0	0	4	0	4	4	0	4	0	0	4	0	29	0	0
0	0	0	0	7	0	0	0	3	0	3	3	0	0	0	0
19	0	0	0	0	3	3	0	3	0	0	15	0	0	3	3
0	3	0	7	0	0	7	0	11	87	0	7	3	0	0	0
0	4	0	0	0	0	0	0	0	4	0	8	0	8	0	0
0	0	0	0	4	0	4	4	0	0	0	16	0	4	4	0
0	16	0	4	0	4	0	4	8	0	8	8	12	0	4	12
38	0	15	3	0	0	3	11	0	19	15	11	7	0	7	3
906	0	0	11	0	0	3	15	0	0	0	3	0	0	15	0
0	946	0	8	0	0	0	4	4	0	0	0	0	0	0	12
0	0	890	7	0	0	0	0	0	15	3	35	15	7	0	0
4	8	4	931	0	0	20	8	0	4	0	0	0	0	0	0
0	15	0	3	940	0	0	11	0	0	0	0	0	0	15	7
0	0	0	4	4	852	44	4	8	8	0	4	4	0	0	8
0	24	0	16	0	12	853	0	4	0	0	16	4	0	0	12
3	0	0	7	0	0	0	960	0	0	0	0	0	3	0	15
0	8	0	0	0	0	16	0	909	4	0	0	0	0	0	4
3	0	0	7	0	0	0	0	0	882	0	15	3	0	0	0
3	0	0	0	0	0	7	7	0	0	948	11	0	0	0	3
0	0	4	4	0	0	0	0	0	0	8	879	8	8	0	0
0	0	0	16	0	4	0	0	0	28	8	60	829	4	12	0
0	0	0	0	0	4	0	0	0	0	0	21	4	932	0	8
4	4	0	8	0	4	0	32	4	0	4	0	0	0	926	12
4	20	0	4	12	4	0	16	4	0	0	12	0	20	0	820

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TABLE 25. CONFUSION MATRIX FOR THE PHONETIC ALPHABET PLU

	Zero	One	Two	Three	Four	Five	Six	Seven	Eight	Nine	Zulu	Quebec	India	Char	Bravo	Tango	Juli	Unif	Romeo	Alpha	Papa
Zero	774	0	5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
One	0	923	0	0	10	5	0	0	5	0	0	5	0	0	0	0	0	16	0	0	0
Two	0	0	893	0	0	0	0	5	0	0	27	0	0	0	0	5	0	0	0	0	0
Three	0	0	0	898	0	0	5	0	5	16	0	5	0	0	0	0	0	0	0	0	0
Four	0	0	0	5	948	0	5	5	0	0	0	0	0	0	0	5	0	11	0	5	0
Five	0	5	0	0	0	809	5	11	0	57	0	0	0	11	0	0	0	0	0	0	17
Six	0	0	0	0	0	0	849	22	16	5	0	16	0	5	0	0	0	0	0	0	0
Seven	5	0	0	0	5	5	21	890	0	0	0	5	0	0	0	5	5	0	0	0	5
Eight	0	0	5	11	11	0	17	5	818	5	0	0	22	0	0	0	5	11	5	0	0
Nine	0	0	0	5	0	34	0	5	0	849	5	0	0	0	5	0	0	0	5	0	0
Zulu	6	0	43	0	6	0	0	6	12	0	826	6	12	0	0	12	0	12	6	0	0
Quebec	0	0	0	0	5	0	56	5	0	5	5	846	0	0	0	5	11	5	0	0	0
India	5	0	11	0	17	0	0	5	5	0	5	5	776	0	0	5	41	41	0	0	0
Charlie	0	0	0	0	0	5	0	5	0	0	0	0	0	938	0	0	0	0	5	0	0
Bravo	0	0	0	5	0	5	0	0	0	0	0	0	0	0	949	0	0	0	0	0	5
Tango	0	0	11	0	5	0	11	0	0	5	0	0	11	0	0	816	0	0	0	0	0
Juliet	0	0	5	0	0	0	0	0	0	5	17	5	57	5	0	0	885	11	0	0	0
Uniform	11	0	0	0	22	0	0	0	0	0	5	0	17	0	0	0	0	902	0	0	0
Romeo	0	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	11	0	942	0	0
Alpha	0	0	0	0	5	0	0	0	0	0	0	0	0	0	16	0	0	11	5	887	22
Papa	0	0	0	0	5	17	5	0	0	11	5	0	0	0	17	0	0	5	0	23	877
Whiskey	0	11	0	0	0	5	0	0	0	0	0	11	0	0	0	11	0	16	0	0	0
Delta	11	0	0	0	5	0	0	11	0	0	0	5	0	0	0	0	0	5	0	11	0
Xray	0	0	0	17	0	0	11	17	0	11	0	0	0	17	0	0	0	0	0	0	0
Mike	0	17	0	5	0	28	5	0	0	34	0	0	0	0	0	0	0	0	0	0	0
November	0	0	0	0	5	0	9	5	0	5	0	0	5	0	0	5	0	11	5	0	5
Victor	0	0	0	5	0	0	85	0	11	0	0	11	5	0	0	11	0	0	0	0	0
Foxrot	0	5	0	0	11	17	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
Yankee	0	0	0	0	0	0	29	23	5	11	5	0	11	0	0	5	0	0	0	0	0
Echo	5	0	0	0	0	0	0	5	0	0	5	0	0	0	0	28	0	5	0	5	0
Golf	0	0	0	0	0	0	11	11	0	0	0	0	0	0	17	0	0	5	0	0	5
Kilo	70	0	17	0	5	0	0	0	0	0	0	0	5	0	11	29	5	11	0	0	0
Hotel	18	0	0	6	0	0	0	6	0	0	0	0	0	0	0	18	0	0	12	0	0
Sierra	18	0	0	0	0	0	0	6	0	0	0	0	0	0	0	6	12	0	0	0	0
Oscar	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
Lima	5	0	0	5	5	0	0	0	5	5	5	0	0	0	0	0	0	29	11	0	0
Enter	0	0	0	0	0	0	0	11	0	5	0	11	11	0	0	17	0	11	0	0	0

87.45% recognised as correct word

# PHONETIC ALPHABET PLUS THE DIGITS AND ENTER

	Unif	Romeo	Alpha	Papa	Whis	Delta	Xray	Mike	Howe	Vict	Foxt	Yank	Echo	Golf	Kilo	Hotel	Sier	Oscar	Lima	Enter
	0	0	0	0	0	5	0	0	0	0	0	0	28	0	124	29	45	0	16	10
16	0	0	0	0	0	0	0	10	0	0	5	5	0	0	1	4	0	2	20	9
0	0	0	0	0	0	0	5	0	0	22	0	0	27	0	20	3	0	2	2	9
0	0	0	0	0	39	0	0	16	0	5	0	5	0	0	4	2	0	2	15	6
11	0	5	0	0	0	5	0	0	0	0	5	0	0	3	6	7	0	4	7	12
0	0	0	0	17	0	0	0	34	0	5	17	0	0	15	3	3	0	39	12	10
0	0	0	0	0	22	0	16	0	0	22	0	0	0	0	3	9	0	4	31	15
0	0	0	0	5	0	0	16	0	5	10	0	0	0	0	9	9	1	9	21	22
11	5	0	0	0	17	0	0	0	0	17	0	22	0	1	2	3	0	4	14	11
0	5	0	0	0	0	0	0	40	5	0	0	5	0	2	10	2	0	7	25	6
12	6	0	0	0	0	0	6	0	0	18	0	12	6	1	32	9	0	4	16	32
5	0	0	0	0	17	0	5	0	5	0	0	5	0	9	4	10	0	6	18	15
41	0	0	0	0	0	0	29	0	5	0	0	0	0	0	17	18	7	2	23	53
0	5	0	0	0	0	0	5	5	0	5	0	0	0	5	26	8	0	4	5	13
0	0	0	0	5	0	0	0	0	0	0	0	5	0	5	23	2	0	7	16	4
0	0	0	0	0	0	0	0	0	0	0	0	11	100	0	36	13	1	2	4	19
11	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5	8	0	0	2	19
902	0	0	0	0	5	0	0	0	5	5	0	0	5	0	21	13	2	0	6	17
0	942	0	0	0	0	0	0	0	0	0	5	0	0	0	5	17	0	3	19	2
11	5	887	22	0	11	5	0	0	0	0	5	0	11	7	35	12	0	6	7	6
5	0	23	877	0	0	5	0	0	0	0	0	0	0	2	12	2	0	19	11	3
16	0	0	0	937	0	5	5	5	5	5	0	11	0	0	0	4	0	1	12	7
5	0	11	0	0	921	0	0	0	5	5	0	0	3	18	7	2	0	4	10	
0	0	0	0	0	0	0	897	0	0	11	5	11	0	2	10	7	0	6	20	28
0	0	0	0	0	11	0	0	891	0	0	0	0	0	0	0	0	0	5	7	0
11	5	0	5	0	0	5	0	867	11	0	5	5	0	39	30	0	1	38	72	
0	0	0	0	0	11	0	11	0	5	765	5	0	22	0	7	7	12	4	15	50
0	0	0	5	5	0	0	5	5	0	0	923	0	0	3	0	7	0	16	19	6
0	0	0	0	0	5	0	11	0	0	5	5	852	5	0	17	19	0	2	18	15
5	0	5	5	0	0	0	5	0	0	5	0	0	909	0	26	12	1	0	3	11
0	5	0	0	5	0	0	0	0	0	0	5	0	0	870	64	29	0	16	17	11
11	0	0	0	0	0	0	0	0	0	0	0	0	11	1	790	16	32	0	14	12
0	0	12	0	0	6	0	0	0	0	6	6	0	6	2	47	879	3	2	14	18
12	0	0	0	0	0	6	0	0	0	6	0	0	0	1	25	20	919	0	9	9
0	0	0	0	23	5	0	11	5	0	0	17	0	0	4	1	2	0	923	17	9
0	29	11	0	0	0	0	0	0	0	5	17	5	0	0	16	18	36	5	867	9
0	11	0	0	0	0	0	17	0	17	46	5	0	5	0	4	5	2	2	7	858

2

## CONCLUSIONS

1. The prototype system, as demonstrated using the adaptation strategy for flight plan filing, has definite potential for application to the enhanced Model 2 of the Flight Service Automation Program.
2. The requirement to spell out every flight plan entry character by character would try the patience of the users. Even at 100 percent accuracy, the protracted length of the transaction diminishes the attractiveness of filing in this manner.
3. The improvement in recognition accuracy with the new data base would raise the performance of the Mass Weather Dissemination Program to a level quite satisfactory for the general pilot population.
4. The dialect study and voice collection effort led to an outstanding improvement in recognition accuracy.

## RECOMMENDATIONS

1. Simplify the procedure for filing a flight plan by voice recognition. Make it unnecessary for the pilot to spell out every flight plan entry character by character.
2. Develop additional software to allow for further correction and edit capability.
3. Develop written instructions for training general aviation pilots on how to use the system effectively.
4. Install a telephone line in the Millville, New Jersey, Flight Service Station to allow volunteer general aviation pilots to access the system at the Technical Center and file simulated flight plans by machine recognition. Project personnel should collect objective and questionnaire data on system performance. Note: Approval from OMB should be obtained prior to testing.
5. Encourage user growth by permitting the system to become progressively more flexible with greater efficiency of input as the user's skill and confidence increase.



## APPENDIX A

### EXPERIMENTAL FLIGHT PLAN TRANSACTIONS

In lieu of presenting a transcript of all of the recorded briefings, we have selected six experimental flight plan transactions that represent various levels of recognition accuracy. Of the six selected, three are VFR and three are IFR. Figures A-1 through A-3 show three VFR transactions that reflect good, fair, and poor recognition accuracy, respectively. Similarly, figures A-4 through A-6 show three IFR transactions that likewise reflect good, fair, and poor recognition. We have defined "good," "fair," and "poor," as follows:

Good = greater than 95 percent

Fair = between 90 percent and 95 percent

Poor = less than 90 percent

Computer: Hello, this is the pilot's automated briefing system. Detailed operating instructions are available for the new or occasional user. Do you wish detailed operating instructions? Please say yes or no immediately after the cue-tone.

User: Negative.

Computer: Say briefing, file, amend, specialist, or close.

User: File.

Computer: Standby to speak your flight plan immediately after the cue-tone. Do you wish to file a VFR flight plan? Say affirmative or negative.

User: Affirmative.

Computer: Did you say affirmative?

User: Yes.

Computer: For the following entries use the phonetic alphabet, numbers, and the words point, slant, hundreds, thousands, and enter. All entries are terminated with the word enter. After the last element of the route of flight has been entered, say the word enter by itself to proceed with your flight plan. You must confirm all entries by saying affirmative or negative. There will be no beep tone when the girl asks a question. Enter aircraft call sign.

User: November Seven Three Seven Kilo.

Computer: November Seven Three Seven Kilo?

User: Yes.

Computer: Continue.

User: Alpha Enter.

Computer: Alpha Attention?

User: No.

Computer: Sorry, try again.

User: Alpha Enter.

Computer: Alpha Enter?

User: Yes.

Computer: Enter aircraft type.

User: Papa Alpha Two Eight Enter.

Computer: Papa Alpha Two Eight Enter?

User: Yes.

Computer: Enter destination identifier.

User: Alpha Charlie Kilo Enter.

Computer: Alpha Charlie Kilo Enter?

User: Yes.

Computer: Enter proposed departure time.

User: One Three Three Five Enter.

Computer: One Three Three Five Enter?

User: No.

Computer: Sorry, try again.

User: One Three Three Five Enter.

Computer: One Three Three Five Enter?

User: Yes.

Computer: Enter estimated time en route.

User: Zero Two Four Five Enter.

Computer: Zero Two Four Five Enter?

User: Yes.

Computer: The following information is recorded on audio tape. Please use natural speech when you answer the question. A silence of two seconds after your response will advance you to the next question. Enter departure identifier.

User: Delaware Airport.

Computer: Enter true airspeed.

User: 120.

Computer: Enter altitude.

User: 7 thousand 5 hundred.

Computer: Enter special equipment code.

User: Tango.

Computer: Enter route of flight.

User: Direct Coyle direct Providence.

Computer: Enter alternate airport.

User: Boston.

Computer: Enter fuel on board.

User: 4 hours and 30 minutes.

Computer: Enter number on board.

User: 2

Computer: Enter color of aircraft.

User: Brown and gold.

Computer: Enter home base.

User: Hantushet.

Computer: Enter pilot's name, address, and telephone number.

User: Subject's name, address and telephone number.

Computer: Enter remarks.

User: EIT O.K.

Computer: Your flight plan has been accepted and filed. Do you require additional assistance?

User: Yes.

Computer: Say briefing, file, amend, specialist, or close.

FIGURE A-1. VFR TRANSACTION — GOOD

Computer: Hello, this is the pilot's automated briefing system. Detailed operating instructions are available for the new or occasional user. Do you wish detailed operating instructions? Please say yes or no immediately after the cue-tone.

User: No.

Computer: Say briefing, file, amend, specialist, or close.

User: File.

Computer: Standby to speak your flight plan immediately after the cue-tone. Do you wish to file a VFR flight plan? Say affirmative or negative.

User: Affirmative.

Computer: Did you say affirmative?

User: Yes.

Computer: For the following entries, use the phonetic alphabet, numbers, and the words point, slant, hundreds, thousands, and enter. All entries are terminated with the word enter. After the last element of the route of flight has been entered, say the word enter by itself to proceed with your flight plan. You must confirm all entries by saying affirmative or negative. There will be no beep-tone when the girl asks a question. Enter aircraft call sign.

User: November.

Computer: Attention?

User: No.

Computer: Sorry, try again.

User: November Seven Three Seven Kilo.

Computer: Kilo Seven Three Seven Kilo.

User: No.

Computer: I'm sorry. Was your first word Kilo?

User: No.

Computer: What was it?

User: November.

Computer: Did you say November?

User: Yes.

Computer: Was the next seven?

User: Yes.

Computer: As was the next three?

User: Yes.

Computer: Was the next seven?

User: Yes.

Computer: Was the next Kilo?

User: Yes.

Computer: Continue.

User: Alpha Enter.

Computer: Please repeat.

User: Enter.

Computer: Alpha enter?

User: Yes.

Computer: Enter aircraft type.

User: Papa Alpha Two Eight Enter.

Computer: Papa Alpha Tango Eight Enter?

User: No.

Computer: Sorry, try again.

User: Papa Alpha Two Eight Enter.

Computer: Papa Alpha Two Eight Enter?

User: Yes.

Computer: Enter Destination Identifier.

User: Alpha Charlie Kilo Enter.

Computer: Alpha Charlie Kilo Enter?

User: Yes.

Computer: Enter Departure Time.

User: One Three Three Five Enter.

Computer: One Three Three Five Enter?

User: Yes.

Computer: Enter Time En Route.

User: Zero Two Four Five Enter.

Computer: Zero Two Four Five Enter?

User: Yes.

Computer: The following information is recorded on audio tape. Please use natural speech when you answer the question. A silence of 2 seconds after your response, will advance you to the next question. Enter departure identifier.

User: Delaware Airpark.

Computer: Enter true airspeed.

User: 120.

Computer: Enter altitude.

User: 7 thousand, 5 hundred.

Computer: Enter special equipment code.

User: Tango.

Computer: Enter route of flight.

User: Direct Coyle direct Providence.

Computer: Enter alternate airport.

User: Boston.

Computer: Enter fuel on board.

User: 4 hours and 30 minutes.

Computer: Enter number on board.

User: 2.

Computer: Enter color of aircraft.

User: Brown and gold.

Computer: Enter home base.

User: Mantucket.

Computer: Enter pilot's name, address, and telephone number.

User: Subject's name, address, and telephone number.

Computer: Enter remarks.

User: ELT O.K.

Computer: Your flight plan has been accepted and filed. Do you require additional assistance?

User: No.

Computer: Thank you. Have a good day.

FIGURE A-2. VFR TRANSACTION — FAIR

Computer: Hello, this is the pilot's automated briefing system. Detailed operating instructions are available for the new or occasional user. Do you wish detailed operating instructions? Please say yes or no immediately after the cue-tone.

User: No.

Computer: Say briefing, file, amend, specialist, or close.

User: File.

Computer: Standby to speak your flight plan immediately after the cue-tone. Do you wish to file a VFR flight plan? Say affirmative or negative.

User: Affirmative.

Computer: Did you say affirmative?

User: Affirmative?

Computer: For the following entries use the phonetic alphabet, numbers, and the words point, slant, hundreds, thousands, and enter. All entries are terminated with the word enter. After the last element of the route of flight has been entered, say the word enter by itself to proceed with your flight plan. You must confirm all entries by saying affirmative or negative. There will be no beep tone when the girl asks a question. Enter aircraft call sign.

User: November Seven

Computer: Please repeat.

User: Three Seven Kilo Alpha Enter?

Computer: Five Three Hundred Alpha?

User: Negative.

Computer: Sorry, try again:

User: November Seven Three Seven Kilo.

Computer: November Seven Three Seven Kilo?

User: Alpha.

Computer: Please repeat.

User: Affirmative.

Computer: Continue.

User: Alpha Enter Enter.

Computer: Alpha Tango Enter?

User: Negative.

Computer: Sorry, try again.

User: Alpha Enter.

Computer: Alpha Enter?

User: Affirmative.

Computer: Enter Aircraft Type.

User: Papa Alpha Two Eight Enter.

Computer: Oscar Hundred Two Lima Enter?

User: Negative.

Computer: Sorry, try again.

User: Papa Alpha Two Eight Enter.

Computer: Papa Alpha Two Lima Enter?

User: Negative.

Computer: I'm sorry — Was your first word Papa?

User: Affirmative.

Computer: Was the next Alpha?

User: Affirmative.

Computer: Was the next Two?

User: Affirmative.

User: Eight.

Computer: Did you say eight?

User: Affirmative.

Computer: Was the next Enter?

User: Affirmative.

Computer: Enter destination identifier.

User: Alpha Charlie Kilo Enter.

Computer: Six Charlie Kilo Enter?

User: Negative.

Computer: Sorry, try again.

User: Alpha Charlie Kilo Enter.

Computer: Alpha Charlie Kilo Enter?

User: Affirmative.

Computer: Enter departure time.

User: One Three Three Five Enter.

Computer: Hundred Three Three Five Enter?

User: Negative.

Computer: Sorry, try again.

User: One Three Three Five Enter.

Computer: One Three Three Five Enter?

User: Affirmative.

Computer: Enter estimated time en route.

User: Zero Two Four Five Enter

Computer: Zero Two Four Five Enter?

User: Affirmative.

Computer: The following information is recorded on audio tape. Please use natural speech when you answer the question. A silence of 2 seconds after your response will advance you to the next question. Enter departure identifier.

User: Delaware Airport.

Computer: Enter true airspeed.

User: 120.

Computer: Enter altitude.

User: 7 thousand, 5 hundred.

Computer: Enter special equipment code.

User: Tango.

Computer: Enter route of flight.

User: Direct Cayle direct Providence.

Computer: Enter alternate airport.

User: Boston.

Computer: Enter fuel on board.

User: 4 hours and 30 minutes.

Computer: Enter number on board.

User: 2.

Computer: Enter color of aircraft.

User: Brown and gold.

Computer: Enter home base.

User: Hawthornet.

Computer: Enter pilot's name, address, and telephone number.

User: No.  
 Computer: Say briefing, file, amend, specialist, or close.  
 User: File.  
 Computer: Standby to speak your flight plan immediately after the cue-tone. Do you wish to file a VFR flight plan? Say affirmative or negative.  
 User: Affirmative.  
 Computer: Did you say affirmative?  
 User: Affirmative?  
 Computer: For the following entries use the phonetic alphabet, numbers, and the words point, slant, hundreds, thousands, and enter. All entries are terminated with the word enter. After the last element of the route of flight has been entered, say the word enter by itself to proceed with your flight plan. You must confirm all entries by saying affirmative or negative. There will be no beep tone when the girl asks a question. Enter aircraft call sign.  
 User: November Seven  
 Computer: Please repeat.  
 User: Three Seven Kilo Alpha Enter?  
 Computer: Five Three Hundred Alpha?  
 User: Negative.  
 Computer: Sorry, try again:  
 User: November Seven Three Seven Kilo.  
 Computer: November Seven Three Seven Kilo?  
 User: Alpha.  
 Computer: Please repeat.  
 User: Affirmative.  
 Computer: Continue.  
 User: Alpha Enter Enter.  
 Computer: Alpha Tango Enter?  
 User: Negative.  
 Computer: Sorry, try again.  
 User: Alpha Enter.  
 Computer: Alpha Enter?  
 User: Affirmative.  
 Computer: Enter Aircraft Type.  
 User: Papa Alpha Two Eight Enter.  
 Computer: Oscar Hundred Two Lima Enter?  
 User: Negative.  
 Computer: Sorry, try again.  
 User: Papa Alpha Two Eight Enter.  
 Computer: Papa Alpha Two Lima Enter?  
 User: Negative.  
 Computer: I'm sorry — Was your first word Papa?  
 User: Affirmative.  
 Computer: Was the next Alpha?  
 User: Affirmative.  
 Computer: Was the next Two?  
 User: Affirmative.  
 Computer: Was the next Lima?  
 User: Negative.  
 Computer: What was it?  
 User: Eight.  
 Computer: Did you say Victor?  
 User: Negative.  
 Computer: What did you say?

User: Affirmative.  
 Computer: Was the next Enter?  
 User: Affirmative.  
 Computer: Enter destination identifier.  
 User: Alpha Charlie Kilo Enter.  
 Computer: Six Charlie Kilo Enter?  
 User: Negative.  
 Computer: Sorry, try again.  
 User: Alpha Charlie Kilo Enter.  
 Computer: Alpha Charlie Kilo Enter?  
 User: Affirmative.  
 Computer: Enter departure time.  
 User: One Three Three Five Enter.  
 Computer: Hundred Three Three Five Enter?  
 User: Negative.  
 Computer: Sorry, try again.  
 User: One Three Three Five Enter.  
 Computer: One Three Three Five Enter?  
 User: Affirmative.  
 Computer: Enter estimated time en route.  
 User: Zero Two Four Five Enter  
 Computer: Zero Two Four Five Enter?  
 User: Affirmative.  
 Computer: The following information is recorded on audio tape. Please use natural speech when you answer the question. A silence of 2 seconds after your response will advance you to the next question. Enter departure identifier.  
 User: Dulavars Airpark.  
 Computer: Enter true airspeed.  
 User: 120.  
 Computer: Enter altitude.  
 User: 7 thousand, 5 hundred.  
 Computer: Enter special equipment code.  
 User: Tango.  
 Computer: Enter route of flight.  
 User: Direct Coyle direct Providence.  
 Computer: Enter alternate airport.  
 User: Boston.  
 Computer: Enter fuel on board.  
 User: 4 hours and 30 minutes.  
 Computer: Enter number on board.  
 User: 2.  
 Computer: Enter color of aircraft.  
 User: Brown and gold.  
 Computer: Enter home base.  
 User: Montucket.  
 Computer: Enter pilot's name, address, and telephone number.  
 User: Subject's name, address, and telephone number.  
 Computer: Enter remarks.  
 User: EIT O.K.  
 Computer: Your flight plan has been filed. Do you require additional assistance?  
 User: Negative, Negative.  
 Computer: Thank you. Have a nice day.

FIGURE A-3. VFR TRANSACTION — POOR

Computer: Say briefing, file, amend, specialist, or close.

User: File.

Computer: Standby to speak your flight plan immediately after the cue-tone.  
Do you wish to file a VFR flight plan? Say affirmative or negative.

User: Negative.

Computer: For the following entries, use the phonetic alphabet, numbers, and the words point, slant, hundred, thousands, and enter. All entries are terminated with the word enter. After the last element of the route of flight has been entered say the word enter by itself to proceed with your flight plan. You must confirm all entries by saying affirmative or negative. There will be no beep-tone when the girl asks a question.  
Enter aircraft call sign.

User: November Four One Zero Whiskey.

Computer: November Tango One Zero Whiskey?

User: No.

Computer: Sorry, try again.

User: November Four One Zero Whiskey.

Computer: November Four One Zero Whiskey?

User: Yes.

Computer: Continue.

User: Bravo Enter.

Computer: Bravo Enter?

User: Yes.

Computer: Enter aircraft type and special equipment code.

User: Golf Two Slant Foxtrot Enter.

Computer: Golf Two Slant Foxtrot Enter?

User: Yes.

Computer: Enter destination identifier.

User: Tango Papa Alpha Enter.

Computer: Tango Papa Alpha Enter?

User: Yes.

Computer: Enter departure time.

User: Zero Eight Five Zero Enter.

Computer: Victor Eight Five Zero Enter?

User: No.

Computer: Sorry, try again.

User: Zero Eight Five Zero Enter.

Computer: Zero Eight Five Zero Enter?

User: Yes.

Computer: Enter estimated time en route.

User: Zero Two Two Zero Enter.

Computer: Zero Two Two Zero Enter?

User: Yes.

Computer: Enter aircraft's true airspeed.

User: Four Four Zero Enter.

Computer: Four Four Zero Enter?

User: Yes.

Computer: Enter departure identifier.

User: Tango Tango November Enter.

Computer: Tango Tango November Enter?

User: Yes.

Computer: Enter Proposed Altitude.

User: Three Niner Zero Enter.

Computer: Three Niner Zero Enter?

User: Yes.

Computer: There is no preferred route for your entry. Enter first route element.

User: Tango Tango November Two Enter.

Computer: Tango Tango November Two Enter?

User: Yes.

Computer: Enter next route element.

User: Romeo India Charlie Enter.

Computer: Romeo India Charlie Enter?

User: Yes.

Computer: Enter next route element.

User: Juliette Five Two Enter.

Computer: Juliette Five Two Enter?

User: Yes.

Computer: Enter next route element.

User: Charlie Alpha Echo Enter.

Computer: Charlie Alpha Echo Enter?

User: Yes.

Computer: Enter next route element.

User: Juliette Seven Five Enter.

Computer: Juliette Seven Five Enter?

User: Yes.

Computer: Enter next route element.

User: Tango Alpha Yankee Enter.

Computer: Tango Alpha Yankee Enter?

User: Yes.

Computer: Enter next route element.

User: Juliette One One Niner Enter.

Computer: Juliette One One Niner Enter?

User: Yes.

Computer: Enter next route element.

User: Enter.

Computer: Enter?

User: Yes.

Computer: Enter remarks.

User: Alpha Delta Charlie Uniform Enter.

Computer: Alpha Delta Charlie Uniform Enter?

User: Yes.

Computer: The following information is recorded on audio tape. Please use natural speech when you answer the question. A silence of 2 seconds after your response will advance you to the next question. Enter alternate airport.

User: St. Petersburg.

Computer: Enter fuel on board.

User: 4 hours.

Computer: Enter number on board.

User: 10.

Computer: Enter color of aircraft.

User: Orange and Brown.

Computer: Enter home base.

User: Philadelphia.

Computer: Pilot's name, address, and telephone number.

User: Subject's name, address, and telephone number.

Computer: Your flight plan has been accepted and filed. Do you require additional assistance?

User: No.

Computer: Thank you. Have a good day.

FIGURE A-4. IFR TRANSACTION — GOOD

Computer: Say briefing, file, amend, specialist, or close.

User: File.

Computer: Standby to speak your flight plan immediately after the cue-tone. Do you wish to file a VFR flight plan? Say affirmative or negative.

User: Negative.

Computer: Did you say negative?

User: Yes.

Computer: For the following entries, use the phonetic alphabet, numbers, and the words points, slant, hundreds, thousands, and enter. All entries are terminated with the word enter. After the last element of the route of flight has been entered, say the word enter by itself to proceed with your flight plan. You must confirm all entries by saying affirmative or negative. There will be no beep-tone when the girl asks a question. Enter aircraft call sign.

User: Romeo Alpha November Two Seven.

Computer: Romeo Alpha November Two Attention?

User: No.

Computer: Sorry, try again.

User: Romeo Alpha November Two Seven.

Computer: Romeo Alpha November Two Attention?

User: No.

Computer: I'm sorry — Was your first word Romeo?

User: Yes.

Computer: Was the next Alpha?

User: Yes.

Computer: Was the next November?

User: Yes.

Computer: What was it?

User: November.

Computer: Did you say Hotel?

User: No.

Computer: What did you say?

User: November.

Computer: Did you say Lima?

User: No.

Computer: Enter aircraft call sign.

User: Romeo Alpha November Two Seven.

Computer: Romeo Alpha November Two X-ray?

User: No.

Computer: Sorry, try again.

User: Romeo Alpha November Two Seven.

Computer: Romeo Alpha November Two Seven?

User: Yes.

Computer: Continue.

User: Five Enter Enter Enter.

Computer: Five Victor Tango Enter?

User: No.

Computer: Sorry, try again.

User: Five Enter.

Computer: Five Enter?

User: Yes.

Computer: Enter aircraft type and special equipment code.

User: November Delta Two Six Slant.

Computer: November Delta Two Six Slant?

User: Yes.

Computer: Continue.

User: Alpha Enter.

Computer: Alpha Enter?

User: Yes.

Computer: Enter destination identifier.

User: Juliette Foxtrot Kilo Enter.

Computer: Juliette Foxtrot Kilo Enter?

User: Yes.

Computer: Enter proposed departure time.

User: Two Zero Three Zero Enter.

Computer: Two Zero Three Zero Enter?

User: Yes.

Computer: Enter estimated time en route.

User: Zero Zero Four Five Enter.

Computer: Zero Zero Four Five Enter?

User: Yes.

Computer: Enter true airspeed.

User: Two Zero Zero Enter.

Computer: Two Zero Zero Enter?

User: Yes.

Computer: Enter departure identifier.

User: Alpha Charlie Yankee Enter.

Computer: Alpha Charlie Yankee Enter?

User: Yes.

Computer: Enter proposed altitude.

User: Five Thousand Enter.

Computer: Five Thousand Attention?

User: No.

Computer: Sorry, try again.

User: Five Thousand Enter.

Computer: Five Thousand Enter?

User: Yes.

Computer: There is no preferred route for your entry. Enter first route element

User: Charlie Yankee November Enter.

Computer: Charlie Yankee November Enter?

User: Yes.

Computer: Enter next route element.

User: Victor One Six Enter.

Computer: Victor One Six Enter?

User: Yes.

Computer: Enter next route element.

User: Enter.

Computer: Enter?

User: Yes.

Computer: Enter remarks.

User: November Oscar November Echo Enter.

Computer: November Oscar November Echo Enter?

User: Yes.

Computer: The following information is recorded on audio tape. Please use natural speech when you answer the question. A silence of 2 seconds after your response will advance you to the next question. Enter alternate airport.

User: Newark.

Computer: Enter fuel on board.

User: 3 hours.

Computer: Enter number on board.

User: 15.

Computer: Enter color of aircraft.

User: White and Blue.

Computer: Enter home base.

User: North Philadelphia.

Computer: Pilot's name, address, and telephone number.

User: Subject's name, address, and telephone number.

Computer: Your flight plan has been accepted and filed. Do you require additional assistance?

User: Yes.

Computer: Say briefing, file, amend, specialist, or close.

Computer: Say briefing, file, amend, specialist, or close.

User: File.

Computer: Standby to speak your flight plan immediately after the cue-tone. Do you wish to file a VFR flight plan? Say affirmative or negative.

User: Negative.

Computer: Did you say negative?

User: Affirmative.

Computer: For the following entries, use the phonetic alphabet, numbers, and the words point, slant, hundreds, thousands, and enter. All entries are terminated with the word enter. After the last element of the route of flight has been entered, say the word enter by itself to proceed with your flight plan. You must confirm all entries by saying affirmative or negative. There will be no beep-tone when the girl asks a question. Enter aircraft call sign.

User: November Four One Zero Whiskey.

Computer: November Four One Zero Whiskey?

User: Affirmative.

Computer: Continue.

User: Bravo Enter.

Computer: Bravo Enter?

User: Affirmative.

Computer: Enter aircraft type and special equipment code.

User: Golf Two Slant Foxtrot Enter.

Computer: Golf Two Slant Foxtrot Enter?

User: Affirmative.

Computer: Please repeat.

User: Affirmative.

Computer: Enter destination identifier.

User: Tango Papa Alpha Enter

Computer: Tango Papa Alpha Enter?

User: Affirmative.

Computer: Enter departure time.

User: Zero Eight Five Zero Enter.

Computer: Zero Eight Five Zero Enter?

User: Affirmative.

Computer: Enter estimated time en route.

User: Zero Two Two Zero Enter.

Computer: Zero Two Two Zero Enter?

User: Affirmative.

Computer: Enter true airspeed.

User: Four Four Zero Enter.

Computer: Four Four Zero Enter?

User: Affirmative.

Computer: Enter departure identifier.

User: Tango Tango November Enter.

Computer: X-ray Tango November Enter?

User: Negative.

Computer: Enter proposed altitude.

User: Three Niner Zero Enter.

Computer: Three Niner Zero Enter?

User: Affirmative.

Computer: There is no preferred route for your entry. Enter first route element.

User: Tango Tango November Two Enter.

Computer: Tango Tango November Two Enter?

User: Affirmative.

Computer: Enter next route element.

User: Romeo India Charlie Enter.

Computer: Romeo India Charlie Enter?

User: Affirmative.

Computer: Enter next route element.

User: Juliette Five Two Enter.

Computer: Juliette Five Two Enter?

User: Affirmative.

Computer: Enter next route element.

User: Juliette Seven Five enter.

Computer: Slant Seven Echo enter?

User: Negative.

Computer: Sorry, try again.

User: Juliette Seven Five enter.

Computer: Juliette Seven Five enter?

User: Affirmative.

Computer: I'm sorry — Was your first word Juliette?

User: Affirmative.

Computer: What was it?

User: Juliette.

Computer: Did you say India?

User: Negative.

Computer: Please repeat.

User: No.

Computer: What did you say?

User: Juliette.

Computer: Did you say Slant?

User: No.

Computer: Enter next route element.

User: Juliette Seven Five enter.

Computer: Juliette Seven Five enter?

User: Affirmative.

Computer: Enter next route element.

User: Tango Alpha Yankee enter.

Computer: Please repeat.

User: Enter.

Computer: Tango Alpha Yankee Victor enter?

User: Negative.

Computer: Sorry, try again.

User: Tango Alpha Yankee enter.

Computer: Tango Alpha Yankee enter?

User: Affirmative.

Computer: I'm sorry — Was your first word Tango?

User: Yes.

Computer: Was the next Alpha?

User: Yes.

Computer: Was the next Yankee?

User: Yes.

Computer: Was the next Enter?

User: Yes.

Computer: Enter next route element.

User: Juliette One One Niner enter.

Computer: Juliette One One X-ray X-ray?

User: No.

Computer: Sorry, try again.

User: Juliette.

Computer: Please repeat.

User: Juliette.

Computer: Enter next route element.

User: Juliette One One Niner Enter.

Computer: Juliette One One Niner Enter.

User: Yes.

Computer: Enter next route element.

User: Enter.

Computer: Enter?

User: Yes.

Computer: Enter remarks.



Computer: Bravo Enter?  
 User: Affirmative.  
 Computer: Enter aircraft type and special equipment code.  
 User: Golf Two Slant Foxtrot Enter.  
 Computer: Golf Two Slant Foxtrot Enter?  
 User: Affirmative.  
 Computer: Please repeat.  
 User: Affirmative.  
 Computer: Enter destination identifier.  
 User: Tango Papa Alpha Enter.  
 Computer: Tango Papa Alpha Enter?  
 User: Affirmative.  
 Computer: Enter departure time.  
 User: Zero Eight Five Zero Enter.  
 Computer: Zero Eight Five Zero Enter?  
 User: Affirmative.  
 Computer: Enter estimated time en route.  
 User: Zero Two Two Zero Enter.  
 Computer: Zero Two Two Zero Enter?  
 User: Affirmative.  
 Computer: Enter true airspeed.  
 User: Four Four Zero Enter.  
 Computer: Four Four Zero Enter?  
 User: Affirmative.  
 Computer: Enter departure identifier.  
 User: Tango Tango November Enter.  
 Computer: X-ray Tango November Enter?  
 User: Negative.  
 Computer: Enter proposed altitude.  
 User: Three Miner Zero Enter.  
 Computer: Three Miner Zero Enter?  
 User: Affirmative.  
 Computer: There is no preferred route for your entry. Enter first route element.  
 User: Tango Tango November Two Enter.  
 Computer: Tango Tango November Two Enter?  
 User: Affirmative.  
 Computer: Enter next route element.  
 User: Romeo India Charlie Enter.  
 Computer: Romeo India Charlie Enter?  
 User: Affirmative.  
 Computer: Enter next route element.  
 User: Juliette Five Two Enter.  
 Computer: Juliette Five Two Enter?  
 User: Affirmative.  
 Computer: Enter next route element.  
 User: Charlie Alpha Echo enter.  
 Computer: Charlie Alpha Echo enter?  
 User: Affirmative.  
 Computer: Sorry, try again.  
 User: Affirmative Alpha Echo enter.  
 Computer: X-ray Alpha Echo enter?  
 User: Negative.  
 Computer: I'm sorry -- was your first word X-ray?  
 User: Negative.  
 Computer: What was it?  
 User: Charlie.  
 Computer: Did you say Charlie?  
 User: Affirmative.  
 Computer: What did you say?  
 User: Charlie.  
 Computer: Did you say point?  
 User: Negative.  
 Computer: Enter next route element.  
 User: Charlie Alpha Echo enter.  
 Computer: Charlie Alpha Echo enter?  
 User: Affirmative.

Computer: What did you say?  
 User: Juliette.  
 Computer: Did you say Slant?  
 User: No.  
 Computer: Enter next route element.  
 User: Juliette Seven Five enter.  
 Computer: Juliette Seven Five enter?  
 User: Affirmative.  
 Computer: Enter next route element.  
 User: Tango Alpha Yankee enter.  
 Computer: Please repeat.  
 User: Enter.  
 Computer: Tango Alpha Yankee Victor enter?  
 User: Negative.  
 Computer: Sorry, try again.  
 User: Tango Alpha Yankee enter.  
 Computer: Tango Alpha Yankee enter?  
 User: Affirmative.  
 Computer: I'm sorry -- Was your first word Tango?  
 User: Yes.  
 Computer: Was the next Alpha?  
 User: Yes.  
 Computer: Was the next Yankee?  
 User: Yes.  
 Computer: Was the next Victor?  
 User: Yes.  
 Computer: Enter next route element.  
 User: Juliette One One Miner enter.  
 Computer: Juliette One One X-ray X-ray?  
 User: No.  
 Computer: Sorry, try again.  
 User: Juliette.  
 Computer: Please repeat.  
 User: Juliette.  
 Computer: Enter next route element.  
 User: Juliette One One Miner Enter.  
 Computer: Juliette One One Miner Enter.  
 User: Yes.  
 Computer: Enter next route element.  
 User: Enter.  
 Computer: Enter?  
 User: Yes.  
 Computer: Enter remarks.  
 User: Alpha Delta Charlie Uniform Enter.  
 Computer: Alpha Delta Charlie Uniform Enter?  
 User: Yes.  
 Computer: The following information is recorded on audio tape. Please use natural speech when you answer the question. A silence of 2 seconds after your response will advance you to the next question. Enter alternate airport.  
 User: St. Petersburg.  
 Computer: Enter fuel on board.  
 User: 4 hours.  
 Computer: Enter number on board.  
 User: 10.  
 Computer: Enter color of aircraft.  
 User: Orange and brown.  
 Computer: Enter home base.  
 User: Philadelphia.  
 Computer: Pilot's name, address, and telephone number.  
 User: Subject's name, address, and telephone number.  
 Computer: Your flight plan has been accepted and filed. Do you require additional assistance?  
 User: No.  
 Computer: Please repeat.  
 User: No.  
 Computer: Thank you. Have a good day.

FIGURE A-6. IFR TRANSACTION — POOR

DATE  
LME